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TECHNOLOGY GROUP

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KEYENCE

ULTRA HIGH-SPEED, FLEXIBLE IMAGE PROCESSING SYSTEM

KEYENCE

Ultra High-Speed, Flexible Image Processing System

XG-8000/7000 Series

New function: LumiTrax™

Integration of camera, lighting and inspection algorithm

THE POWER TO TAKE YOU AHEAD



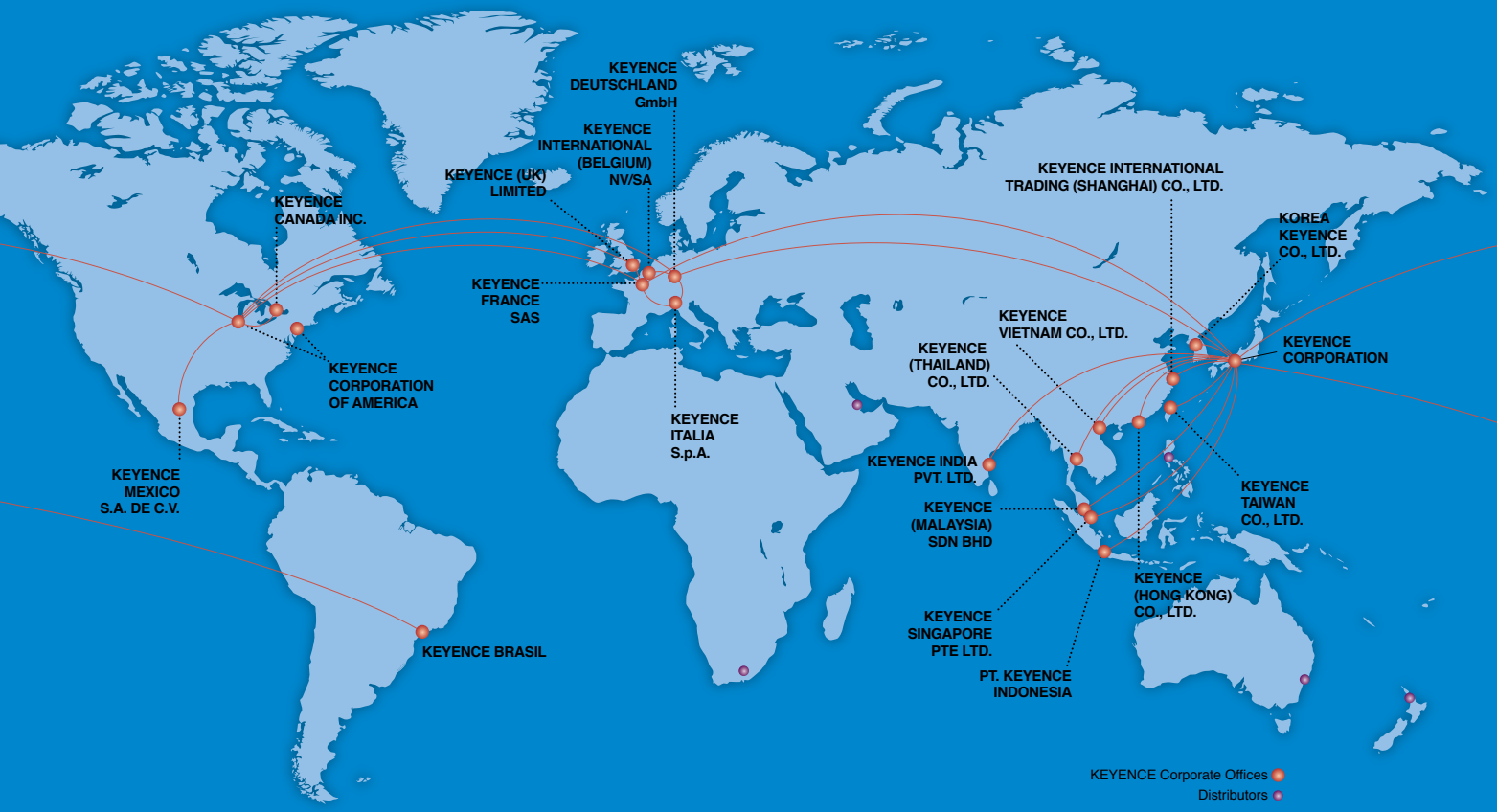


XG-8000 Series Ver. 5.4

XG-7000 Series Ver. 4.3

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LumiTrax™



THE EVER-EVOLVING KEYENCE VISION SYSTEMS CONTINUE TO OFFER THE SOLUTIONS AND SUPPORT THAT MEET GLOBAL CUSTOMER NEEDS

- Image processing solutions used by the professionals
- Complete selection including peripherals and free trials
- Instant delivery throughout the world
- Direct support from a highly trained team

Peripheral Equipment

The majority of the extensive product line up such as cameras, controllers, lighting equipment and peripherals are available for immediate delivery.
KEYENCE offers a complete solution and the support for all your image processing needs.


Vision Systems


Illumination


Lenses


Monitors

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THE EVOLUTION OF KEYENCE MACHINE VISION SYSTEMS

The first KEYENCE vision system



VX Series



CV-100/300 Series



CV-500/700 Series



XV Series



CV-2100/2600 Series

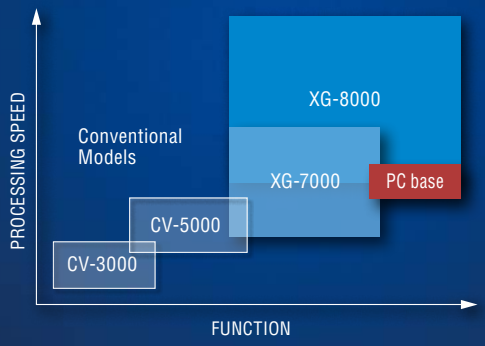


CV-5000 Series



CV-3000 Series

Progression of KEYENCE Vision Systems





XG-7000/8000 Series

1980s

The VX Series
The first image processing system, is developed for general image processing.

2003s

CV-2100
High-speed general-purpose vision system incorporating twin processors and digital transfer camera is released.

2005 to 2008

CV-3000/CV-5000
Raises the bar for machine vision performance with 4 monochrome/color camera connectivity, unmatched speed, and the industry's most user friendly programming interface.

2010

XG-7000
A new approach to vision with customization and simple operating methods that greatly reduces programming difficulty.

2011

XG-8000
Multi-camera and line scan connectivity with multi-core processing providing even greater application solving capabilities.

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WORLD'S MOST POWERFUL VISION SOFTWARE



Providing a system where any user can create
the ideal vision solution easily and quickly.
The XG Series is a breakthrough in vision system technology
that provides the flexibility needed to solve any application.

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WORLD'S MOST POWERFUL MULTI CAMERA HARDWARE



Touch Panel

Line Scan Camera

Area Camera

Select from a family of cameras ranging from standard VGA to 21 megapixel to line scan cameras. The XG Series has an expandable platform that allows up to 8 camera connections on one controller.

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EASY SETUP USING THE TOUCH PANEL DISPLAY





With the addition of CA-MP120T touch panel and VNC server functionality, the XG Series has never been easier to use! The touch panel can be used online to make quick changes to the program and VNC can be used to access the XG over a network through multiple devices.

Touch Panel

4WAY

Controller

SIMPLE SETUP USING THE HANDHELD CONTROLLER





Creation of a program can be done on-line using the handheld controller. After creation, verification and editing can be conducted to increase the inspection accuracy without stopping the line using the 'Online Re-Test' function during operation. This allows the re-testing of stored images even during operation based on images saved to the internal buffer or to an FTP server. Program changes can be tested on-site without influencing the current production.

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PC INTERACTION WITH MOUSE CONTROL



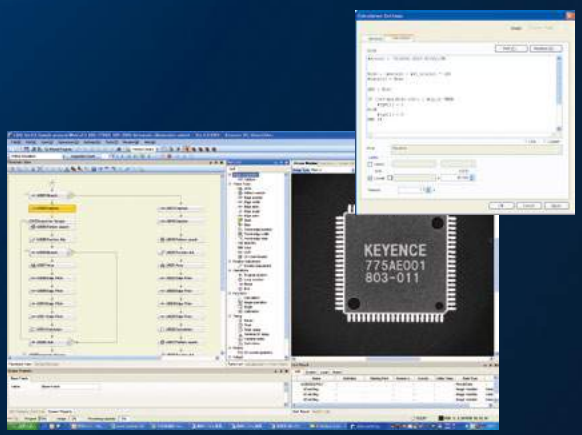
Settings can also be verified offline. Using stored images output by the controller during operation, the PC simulator mimics on-site result data of the hardware controller.
Even if the equipment cannot be stopped, the statistical analysis function of the simulator conducts the same action as the actual controller. After confirming the optimal settings with the simulator, the program setting can be uploaded to the controller providing seamless and efficient interaction with the controller.

Simulator+

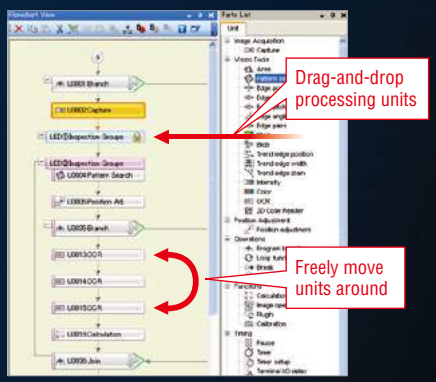
APPROACH

VisionEditor

INTEGRATED DEVELOPMENT ENVIRONMENT



New user-defined image development process using a highly efficient flow chart system, powerful algorithms and C-language Unit.



Creation of the image processing flow is made very intuitive with operations such as drag and drop. Extreme flexibility is possible through the combination of flexible calculation processing, abundant vision processing tools, conditional branching and repetitive processing.

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XG PERFORMANCE

Flexible hardware
Powerful Inspection Toolset
User friendly interface
Intuitive programming flow
Increasing speed, stability and quality to stay at the forefront of the vision market



Hardware

Reliable and ultra high-speed hardware design

- **Multi core Processor**
- **Solid state hard drive**
- **Integrated lighting controller**
- **2K, 4K, 8K line scan camera support**
- **Touch screen control**

CAMERAS Page 22
HARDWARE Page 28
PRE-PROCESSING Page 31

Cameras

Simultaneous use of up to 8 cameras at once.
22 color & monochrome area cameras and 3 line scan camera options.

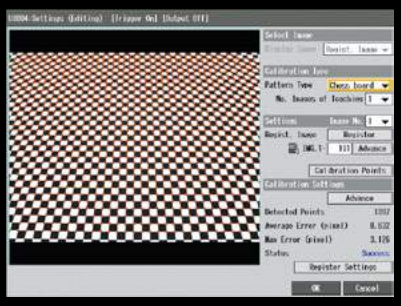
- **High speed(16x) 470k, 2 mega & 5 megapixel**
- **High-resolution 21 megapixel**
- **Ultra small 12 mm (0.47")**
- **2K, 4K, 8K line scan camera**



Pre-Processing

Optimizing the image using advanced pre-processing functions

- **Filters**
- **Image operation & Image stitching**
- **Calibration unit**
- **Color processing**
- **Automatic HDR image creation**



INDUSTRY SPECIFIC FUNCTIONALITY



SEMICONDUCTOR Page 10



ELECTRICAL Page 12



AUTOMOTIVE Page 14

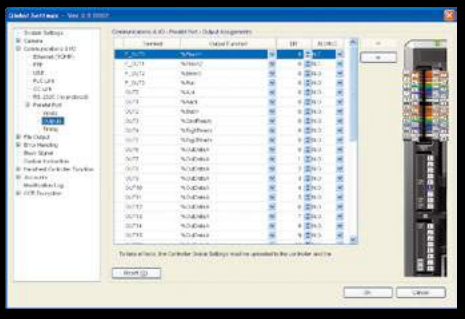
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Tool Set

Abundant inspection algorithms, variables and calculations.

- Stain
- Trend edge
- Trend edge stain
- OCR
- 1D/2D
- Image calibration
- Pattern search
- Calculation / Scripting
- Loop
- Branching



Input/Output

Simpler, customizable control

- Discrete I/O
- FTP server
- EtherNet/IP™
- PROFINET
- TCP/IP
- RS-232C
- CC-Link
- PLC-Link
- USB

EtherNet/IP

PROFINET

TOOL SET Page 38

INTERFACE OPTIONS Page 44

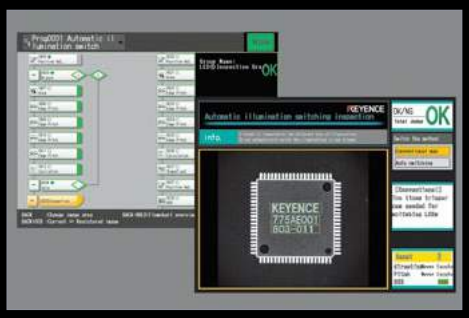
INPUT OUTPUT Page 46

VISION EDITOR Page 48

GUI Creation

A custom user-interface anybody can use

- VisionTerminal
- Simulator +
- Mouse operation
- Simple pendant adjustment



VisionEditor

Development of a complete vision solution

- C Plug In
- ActiveX Control
- Flowchart creation
- Debugging
- Testing
- Customization





FOOD & PACKAGING Page 16

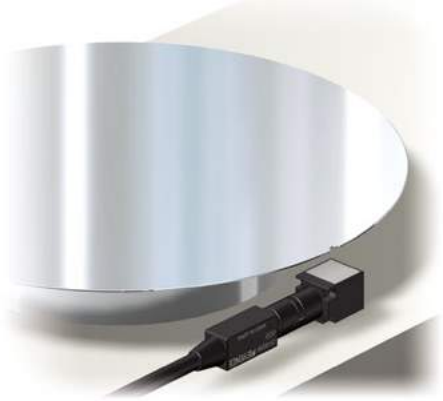


MEDICAL & PHARMACEUTICAL Page 18



AUTOMATION Page 20

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Wafer Alignment

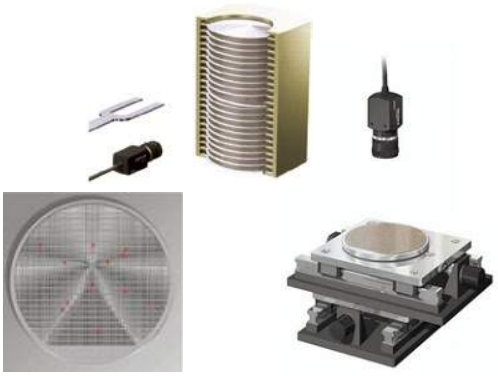
The XG Series machine vision systems allow easy detection of the notch on a wafer for alignment purposes in the fab.

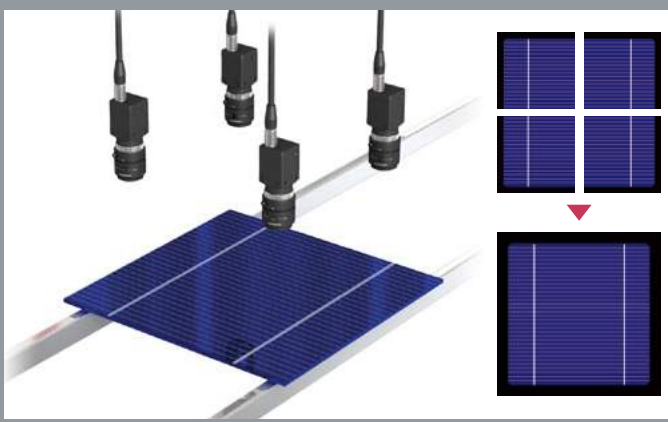
The vision system can detect the notch as the wafer is spun past the camera or find the location of the notch around the circumference when the wafer is presented.

Process Control

Vision systems can be used in a variety of front end and back end process control applications in the semiconductor industry.

Ranging from the checking of FOUPs for mis-fed/double wafers to image analysis of IC's before dicing occurs, multiple or single camera systems can be taken advantage of for automating the process.





Visual Inspection

Visual inspections of parts for defects (such as flaws, dents, cracks and scratches) can be performed as part of a line production process with a vision system.

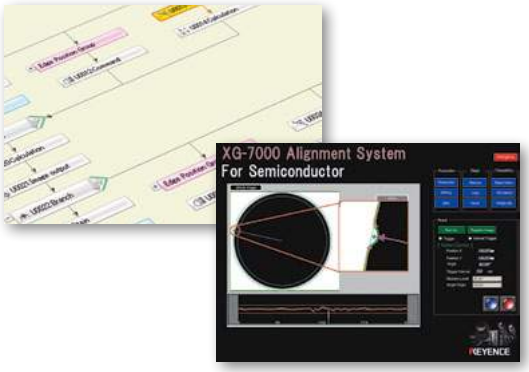
The high speed, high-resolution line scan cameras of the XG-8000 Series can ensure minute defects can be quickly and reliably detected.

Powerful Hardware Design

The XG hardware is well suited for the semiconductor clean room environment. Featuring a fanless design, solid state hard drive, pressure sensitive HMI and super small cameras, this system can be confidentially implemented in such an environment.



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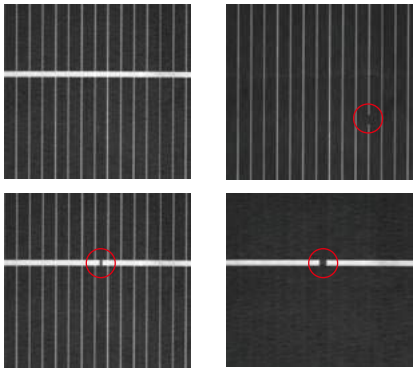
Embedded Functionality

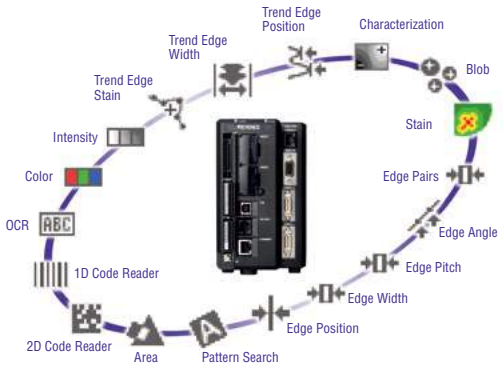
The flowchart programming structure, freely assignable outputs, scripting, custom commands and ActiveX component make it very easy to integrate and embed the XG Series vision system as part of a machine or process.

High End Image Processing

The XG Series wide range of pre-processing filters and image operations make it easy to enhance and manipulate images for stable, reliable performance.

Filters can be set to work in either X, Y or XY directions as well as being combined and freely moved around to create the optimal image required.





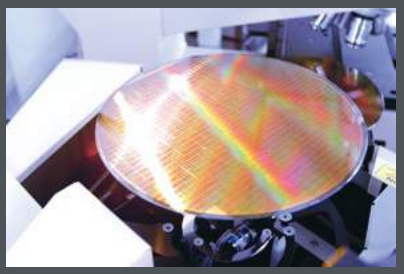
Unique Toolset

Featuring over 18 unique vision tools that can be freely combined in a flowchart structure, the XG can be easily configured to semiconductor orientated applications. Tools like Trend Edge Stain can be used for notch detection at the same time as 2D Code Reader and OCR for wafer identification and traceability.

KEYENCE ADVANTAGE

Global Support

Many companies involved in the manufacturing of semiconductors appreciate the global nature of the industry and KEYENCE is no exception. With offices spread throughout US, Europe and Asia, providing direct high level technical support through local offices is something we pride ourselves on.



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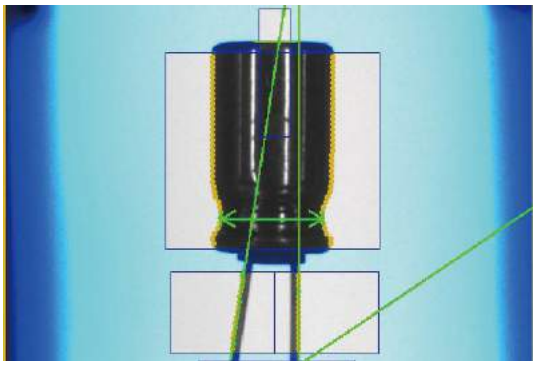


PCB Inspection

The XG Series machine vision system is the perfect machine vision system for verifying all the electrical components on a PCB. Offering a multitude of camera options including 21 megapixel, line scan and 8 area cameras on one controller, PCBs can be automatically inspected to a high detail.

Multiple Feature Inspection

The XG Series comes with a wide range of vision tools that can be adapted for multiple inspections. With an extremely flexible approach to programming, as many tools as required can be combined so all features of a part can be inspected in one step.





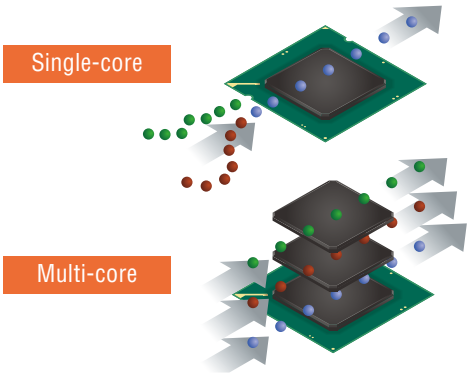
Electronic Housing Inspection

The housing of electronic devices can be inspected using the XG Series. With multiple camera connectivity, individual areas and overall inspections can be made at the same time without the need for multiple inspection stations.

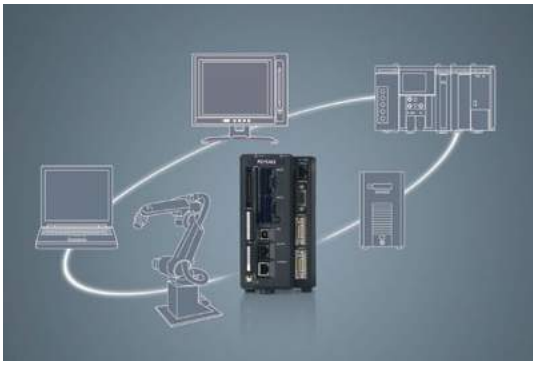
Optimal Hardware Architecture

Realize faster inspection times with the powerful XG Series vision system! The powerful hardware design of the XG Series dedicated to vision processing allows for improved production line performance.

The new multi-core processor of the XG-8000 Series and high speed cameras ensures efficient and optimal handling of inspection processes all the way from image capturing, through processing to generating results and outputs.



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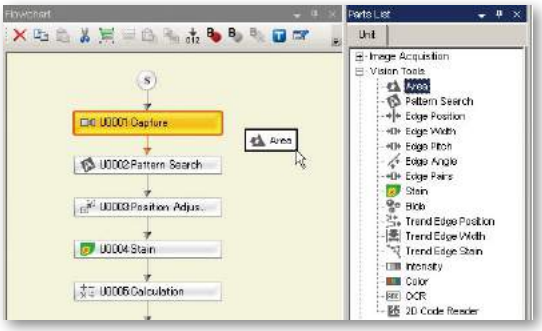


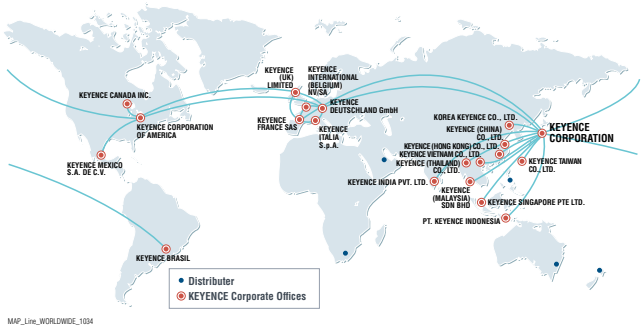
Seamless Integration

Easily integrate industrial robots and PLCs with the XG Series vision system. The XG features EtherNet/IP™, PROFINET, RS-232C, Discrete I/O, ActiveX and more. With a wide range of communication protocols, integrating the XG into your machine, PLC, robot, or controls should be worry-free.

Flexibility & Power

The XG Series has the tools to make the most complicated applications simple. Flowchart programming allows for a step by step approach to developing a solution to be easily realized. With the VisionEditor software, adding another set of inspections is as easy as picking the tools and dragging them into the existing flowchart.





Global Support

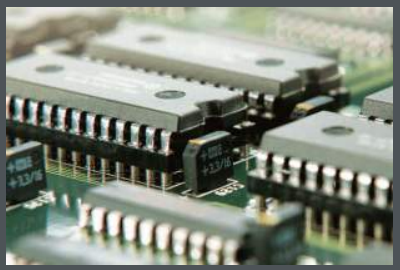
KEYENCE understands the global market and the companies that exist in it. With offices located worldwide, support, expertize, and parts are easily within reach.

Local sales support is readily available through our highly trained personnel in person, via the phone, e-mail, or web conference.

KEYENCE ADVANTAGE

Toolset

Perform all of your inspections using the different vision tools the XG Series offers. From measurement to identification to quality inspection, let the powerful toolset of the XG solve your application.



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AUTOMOTIVE



Engine Component Inspection

Inspections on engine components are critical and failing to identify bad parts can be a costly problem. The XG Series allows for 100% inspection of a multitude of different automotive parts such as bad casts, misaligned bores, or cracked gears.

With the ability to store up to 1000 programs, the XG can be quickly switched during a product changeover without the need for any downtime or re-configuration.

VIN Verification

Using the built in 2D code reader and the OCR tool, the 2D code and human readable code can be easily compared. This eliminates the need for two separate devices to be used and integrated together. The XG can simply give a pass/fail signal making VIN checking an easy process.

In addition, the pre-processing tools of the XG can account for a wide range of variations adding to the stability and reliability of the system.





Taillight Inspection

The colors of the tail light, turn signal, and reverse signal can all be inspected with a single color camera and the color tool. Each LED of the taillight and overall brightness can be checked as the taillight is turned on and adjusted as required.

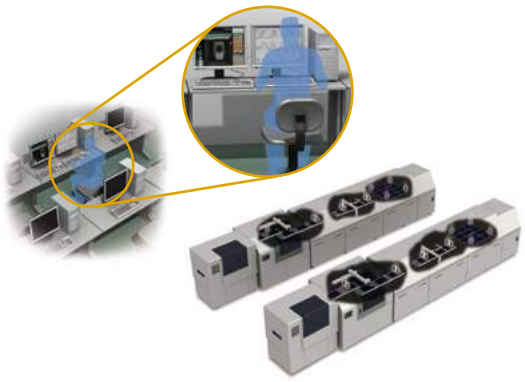
LED brightness and intensity distribution of the taillight can also be stored via FTP for record keeping and traceability.

Character Inspection on Cast Metal

The concave-convex surface features like characters on cast metal parts can be easily extracted with the new LumiTrax function. The target background information is ignored and just the surface features are analyzed for easy OCR or other types of inspections.



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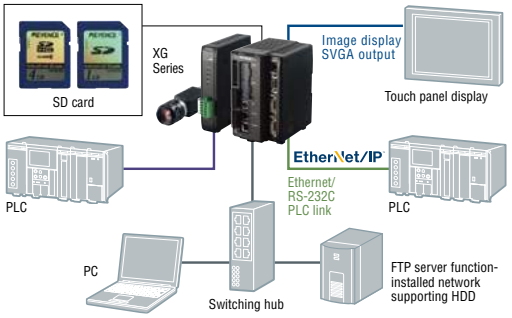
Production Control

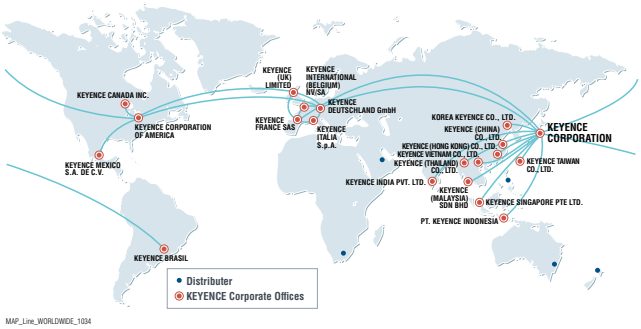
The XG Series has the flexibility to be tied into an existing network on a factory floor. The remote desktop and remote connectivity functions of the VisionTerminal software not only allow for data logging but also complete control of the system.
Multiple systems can be displayed and controlled all at once via a LAN or VPN connection. Additionally, this the VNC server function means the systems can be individually controlled through other devices.
All this makes the remote management of systems and generation of production reports very easy to achieve.

Seamless Integration

With many industry standard communication protocol options, integration into an existing setup is rarely an issue. The XG can simultaneously communicate directly to a robot to relay a position via RS-232C, send data via EtherNet/IP™ to the PLC and be controlled on critical or time sensitive signals through discrete I/O all at the same time.

As this functionality is handled by a separate processor so there is no negative effect to the image processing speed and capability of the system.





Global Support

KEYENCE understands the global market and the companies that exist in it. With offices located worldwide, support, expertize, and parts are easily within reach.

Local sales support is readily available through our highly trained personnel in person, via the phone, e-mail, or web conference.

KEYENCE ADVANTAGE

Return on Investment

Stopping defects before they reach the market is an essential part of Poka Yoke and KEYENCES's range of machine vision can help make sure no costly returns occur.

Featuring a suite of field-proven defect inspection, classification, statistical, and production monitoring tools, the XG Series can help make sure defects are prevented before they occur.



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FOOD & PACKAGING



Packaging Web Inspection

By adding line scan technology into the XG Series, film based web inspections can be easily setup. Multiple line scan cameras can be used across the width of the web and encoders wired directly into the controller ensuring complete web inspection.

The stain and characterization tools, along with target classification, also allow for defects to be found, classified and their place on the web recorded for later post processing.

Thread Inspection

With the wide range of tools of the XG Series, multiple aspects of a bottle thread can be inspected all at once. Features such as thread width, pitch, diameter, and trends can all be measured while defects such as marks, short shot, and flash can also be detected. In addition, the geometric calculations allow for positional and angular data to be calculated based on detected points.

All this processing can occur in a matter of milliseconds with the result being combined into a simple pass/fail signal for a reject mechanism to work off of.





Stamped Characters on Packaging

Using the LumiTrax function, the printed patterns of the packaging is ignored while only the stamped lettering is extracted. This allows reliable inspection of date/lot codes on packaging that has a variety of printed backgrounds and colors.

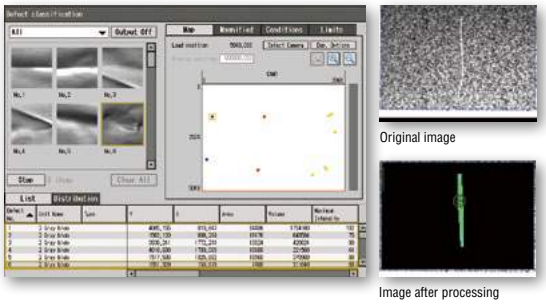
Multi-camera Hardware

Due to the multi-camera connectivity of the XG Series, both line scan and area scan technologies can be taken advantage of for complete product inspection.

A can or bottle can be rotated in front of a line scan camera and under an area camera so that the product can be fully inspected for defects such as holes, short shot and flash. By directly connecting an encoder, product handling and changes in production speeds can be all accounted for with minimal difficulty.



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Runtime Utilities

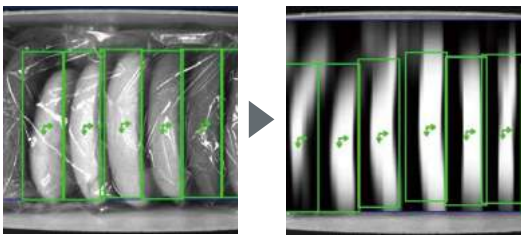
Runtime utilities such as target classification, statistics, retest mode and image archive add an extra dimension of power to the XG during production.

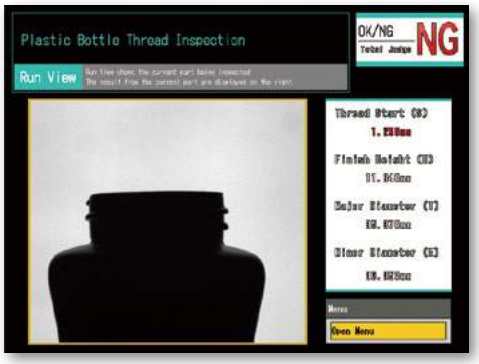
These utilities allow production to be monitored, checked, and settings dialed in as required without affecting the inspection time or incurring downtime on the line.

In addition, the remote networking capability of the system means production can be checked from multiple locations both on and off site.

Image Processing

With an endless list of different materials and designs being used for labeling and packaging, it may be difficult to have the right lighting for every application. With the wide array of pre-processing image filters available on the XG, different filter combinations can be freely used and applied to each inspection to create the best image possible for processing.





Customized Interfaces

Create custom GUIs and menu buttons for easy control of the program. Buttons can function like shortcut buttons to open statistics, view failed images, or even change tolerances without taking the program offline. The XG Series interface is fully customizable to fit every need.

KEYENCE ADVANTAGE

Production Monitoring

Production monitoring is an essential part of the food and packaging industry. No consumer likes to receive bad product and the implications of a tampered product reaching a consumer can be very significant. On the factory floor, the fully customizable user interface can be controlled either with the CA-MP120T touch screen or the handheld controller for on-site changes. The remote connectivity capability of the XG Series controller means the system can be monitored and controlled from a remote PC either on a LAN or VPN connection. In addition, VisionTerminal also allows data logging for the easy creation of production reports.



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MEDICAL & PHARMACEUTICAL





Tape Seal Inspection

Even when unexpected specular reflection occurs when the product is tilted, the glare of the packaging can be canceled using the LumiTrax function. Ambient light can also be removed to provide a very stable inspection.

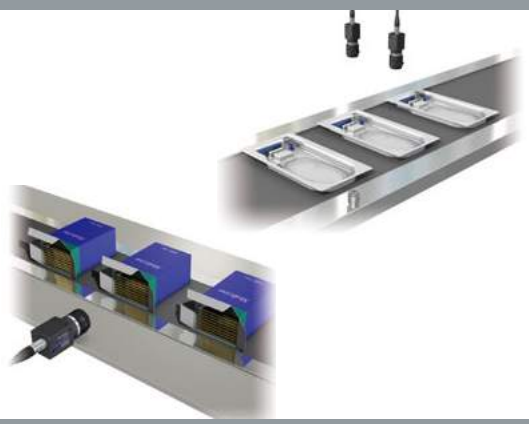
Sorting & Process Control

Machine vision systems can be used as part of process control during medical device and drug manufacturing.

The XG Series can be easily embedded into a system to keep it secure while providing important data to help control or assist with the manufacturing process.

In addition, the information provided from the vision system can be used to produce statistics, production and process reports.





Inspection

A vision system can be used on a production line as a simple checking system to make sure all parts are present inside a medical package.

Unlike a sensor, the vision system can look over an area checking all parts are present based on the characteristics of parts (size, shape, color etc.).

Having space for holding up to 1000 programs, the XG Series allows for the storage and easy calling of different recipes based on production cycles without re-programming.

Production Monitoring

Being able to run reports and obtain data from the production process is an essential function of everyday medical manufacturing. The VisionTerminal software and FTP image/data output functionality of the XG Series make it very easy to create and put such reports together.



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Image Processing

Medical devices are often made from stainless steel or shiny plastic with many contours. For reliable inspection of such targets, the XG Series includes easy to use, yet highly sophisticated image processing functions such as HDR, Shading Correction and Fine Color.

Powerful Toolset

The XG Series toolset includes both quality and traceability vision based tools. The ID and OCR tools can be used to verify products while defect tools (such as stain) can confirm product quality against user determined specifications.





Hardware/Embedded System

The XG Series features an easy to use ActiveX component simplifying the process of embedding it as part of a machine. The stand-alone non-PC hardware platform and option driven setup method also help make system validation as painless as possible.

KEYENCE ADVANTAGE

Traceability

Keeping track and monitoring production in the medical and pharmaceutical industry is very important.

To meet these essential requirements, the XG Series features numerous utilities including custom menus, password driven user access, unit/program locking, modification logging, image archive and statistical reporting.



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Multi-Camera Inspection

The XG-8000 Series is the ultimate flexible stand-alone camera system, by allowing for the simultaneous attachment and processing of up to 8 different cameras and light sources at one time. This means the right camera can be selected for the application with the flowchart programming design bring everything together for efficient processing.

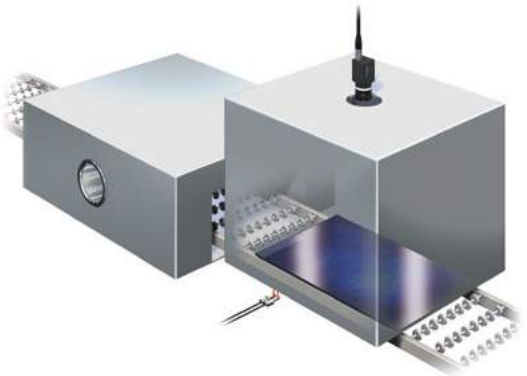
The unique hardware and flowchart design also make it quick and easy to add extra cameras at a later date with minimum difficulty and redesign.

Complete System

The XG Series level of flexibility allows for many different applications to be solved with the same system. Whether it be part sorting, process control, measurement & gauging, or traceability, all the tools are there. The wide range of on-board utilities also allow for quick and easy implementation, monitoring, and debugging of a system once deployed.

The accompanying XG PC software suite (VisionEditor, Simulator+ and VisionTerminal) allow for different levels of users to also take advantage of the XG features and benefits.





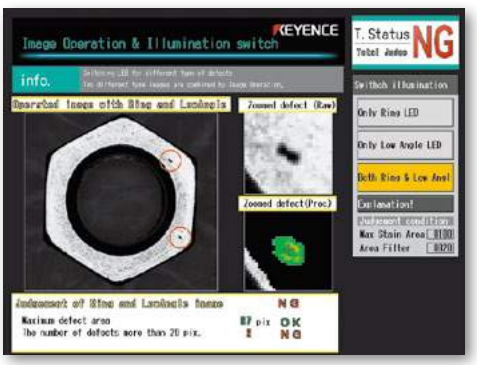
Integrated Vision Inspection

The XG hardware is purposely designed for optimal machine vision performance. The separate controller allows for a small camera footprint and peak performance as a processor does not have to be housed in the same space. This concept also allows for the intelligent design and use of multiple processors together. Each processor in the XG has a set purpose for efficient image processing and machine integration.

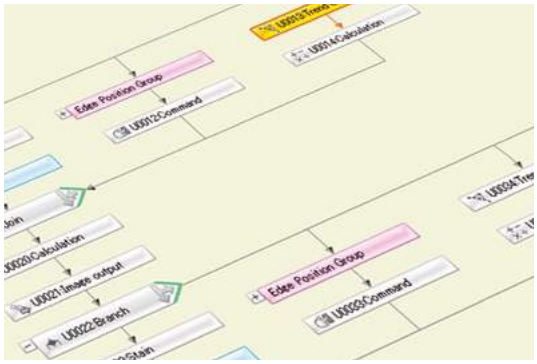
Coupled with this, the controller has a wide range of onboard I/O and communication options allowing for easy connectivity to a PLC and other machine controls.

Image Processing

Any heavy machine vision user appreciates the need for a good wealth of powerful yet easy to use image processing functions. The XG has 2 main sets of image processing functions. Image operation allows new images to be created outside of a tool for efficient programming and image enhancement filters can be individually applied per vision tool to ensure stable processing.



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Flexibility

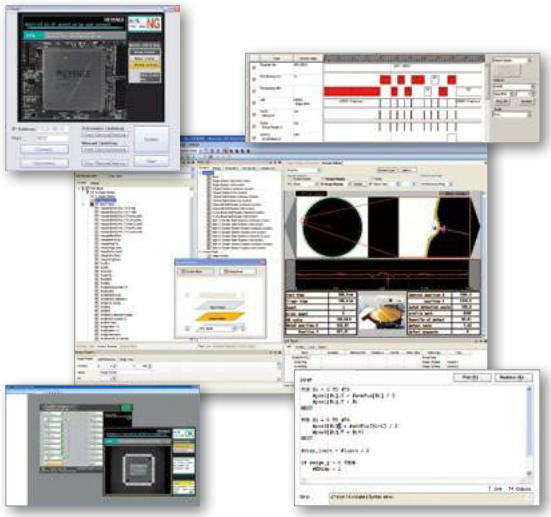
The XG is all about power and flexibility in one simple package. The hardware enables any combination of cameras and lights to come together while the flowchart software platform allows for quick development of a structured solution. The C Plug In unit allows for custom functions to be created while removing the timely engineering processes associated with PC based vision systems.

Development & Debugging

In the development of a machine vision solution, debugging and troubleshooting are essential tools. KEYENCE's XG VisionEditor software comes with a host of debugging tools for testing solutions, tracking operations, analyzing results, finding static/dynamic errors, and version compatibility.

Customization

The XG Series allows for easy customization and styling based on the end users requirements. Logos, screens, menus, and button operations can all be configured as desired. The easy to use ActiveX component also allows for PC software to be configured to interact with the XG for direct monitoring or control as required.



Communication Monitoring & Diagnostics

Analyzing the I/O communications of the XG is made easy using the Monitoring & Diagnostics utilities. The discrete I/O, RS-232C, EtherNet/IP™ & PROFINET communications can be checked and monitored. Inspection times and discrete I/O timing can also be recorded and analyzed in detail using the Trace Log function.

KEYENCE ADVANTAGE

After Sales Support

KEYENCE is well known throughout industry for providing the best customer support and machine vision is no exception. In addition to providing application testing services we offer on-site customer support, technical phone support, programming assistance, and free customer training.

To help already experienced machine vision users get over the initial learning curve and to become familiar with the XG Series, we also offer a free program conversion service*.

Our machine vision experts are well versed in vision systems from many different vendors and will gladly assist your learning by providing an XG version of an existing program you may already have.



* Not all functions from other manufacturers can be guaranteed to be converted.

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Vast lineup of cameras covering every need.

SELECT THE BEST CAMERA FOR THE APPLICATION WIDEST RANGE



The industry's widest variety of cameras can provide the ideal solutions for applications, such as a 21 megapixel camera for inspections requiring extremely high-resolution, a 16x high-speed camera for the inspection requiring fast processing, and a compact camera for the installation in a tight space.

		Model	Specification	Capture range (pixels)	Image transfer time
21 megapixel camera series	 16x 21MEGA DIGITAL	CA-H2100M CA-H2100C	16x high-speed monochrome 16x high-speed color	5104 × 4092	109.9 ms
5 megapixel camera series	 16x 5MEGA DIGITAL LumiTrax compatible	CA-HX500M CA-HX500C	16x high-speed monochrome 16x high-speed color	2432 × 2040	27.6 ms[*1]/50.3 ms[*2] 29.0 ms[*1]/52.4 ms[*2]
	 11x 5MEGA DIGITAL	XG-H500M XG-H500C	11x high-speed monochrome 11x high-speed color	2432 × 2050	61.2 ms 61.2 ms
2 megapixel camera series	 16x 2MEGA DIGITAL LumiTrax compatible	CA-HX200M CA-HX200C	16x high-speed monochrome 16x high-speed color	1600 × 1200	11.6 ms[*1] (20.1 ms[*2]) 11.6 ms[*1] (20.2 ms[*2])
	 7x MEGA DIGITAL	XG-H200M XG-H200C	7x high-speed monochrome 7x high-speed color	1600 × 1200	29.2 ms 29.2 ms
	 MEGA DIGITAL	XG-200M XG-200C	Monochrome Color	1600 × 1200	58.5 ms 58.5 ms
	 SUPER-SMALL DIGITAL	XG-S200M XG-S200C	Ultra-compact monochrome Ultra-compact color	1600 × 1200	58.5 ms 58.5 ms
470,000 pixel camera series	 16x HI-SPEED DIGITAL LumiTrax compatible	CA-HX048M	16x high-speed monochrome	784 × 596 512 × 480	2.9 ms[*1]/5.2 ms[*2] 1.7 ms[*1]/2.8 ms[*2]
		CA-HX048C	16x high-speed color	784 × 596 512 × 480	2.9 ms[*1]/5.3 ms[*2] 1.7 ms[*1]/2.9 ms[*2]
310,000 pixel camera series	 7x HI-SPEED DIGITAL	XG-H035M XG-H035C	7x high-speed monochrome 7x high-speed color	640 × 480	4.7 ms
	 HI-SPEED DIGITAL	XG-035M XG-035C	Monochrome Color	640 × 480	16.0 ms
	 ULTRA-SMALL DIGITAL	XG-S035M XG-S035C	Ultra-compact monochrome Ultra-compact color	640 × 480	16.0 ms

*1. When the CA-EC80HX/EC80L or XG-EC80L camera input unit is used with the XG-8000 Series controller. The transfer speed is 16x.
*2. When used with the XG-7000 Series controller, or when the CA-EC80 or XG-EC80 camera input unit is used with the XG-8000 Series controller. The transfer speed is 11x.

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LumiTrax™

A FUSION OF HIGH-SPEED CAMERAS WITH INTELLIGENT LIGHTING AND AN ADVANCED PROCESSING ALGORITHM

The image of a target is captured with the newly developed ultra high-speed camera and controlled, directional lighting. This is a completely new image capture method that creates shape (concavities/convexities) and texture (pattern) images by analyzing multiple images obtained with lighting from different directions. This eliminates the variation in targets and the influence of surrounding environment that prevent stable inspection. Now any user can easily create images in much less time and without the experience previously required.

Newly developed LumiTrax™ system will solve problems.



Ultra high-speed CMOS image sensor & dedicated control IC
CA-HX Series

+

Ultra high-intensity LED & partial lighting control circuit
CA-DRWxX Series

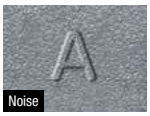
+

Instantaneous analysis of multiple images for creating shape/texture images
XG-8000 Series

Problems with conventional image creation

■ Variation in the surface condition of targets

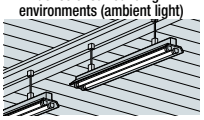




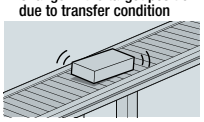




■ Influence of surrounding environments (ambient light)



■ Change in the target position due to transfer condition



Much trial and error is need to select the optimum lighting solution...



Application 1

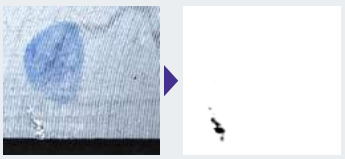
Extract shape (concavities/convexities) information only without being affected by surface condition.

■ Inspection of embossed printing



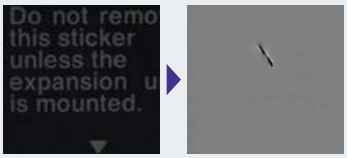
Inspect the concavities and convexities of the embossed printing while ignoring the printing on the package.

■ Inspection of defects on a metal surface



Detect only dents, cracks, and other defects while canceling residual cleaning agent, dirt, and fine hairlines.

■ Inspection of defects in printing



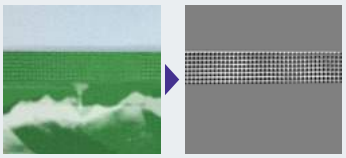
Create an image by extracting defects only without being affected by complex printing in the background.

■ Inspection of marking on a metal casting surface



Enhance the marking that has larger concave/convex information from an irregular casting surface.

■ Inspection of heat sealing width



Detect and extract the concave/convex information of sealed section that shows almost no change in color or shading.

Application 2

Extract texture (pattern) information only by suppressing halation and ambient light.

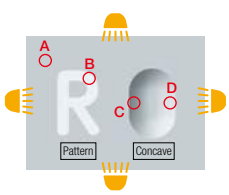
■ Inspection of printing on a film

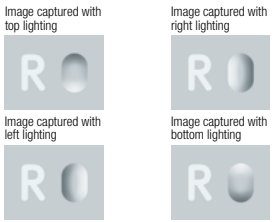


Remove halation and ambient light that affects inspection to ensure stability.

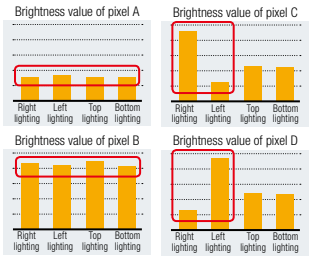
Principle of LumiTrax™ processing

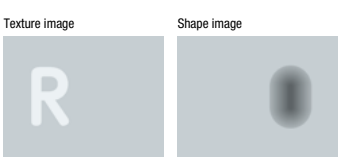
1. Capture images with lighting applied from different directions at ultra high-speed.





2. Analyze the change in the brightness value of each pixel and create separate images of shape (concavities/convexities) and texture (pattern).





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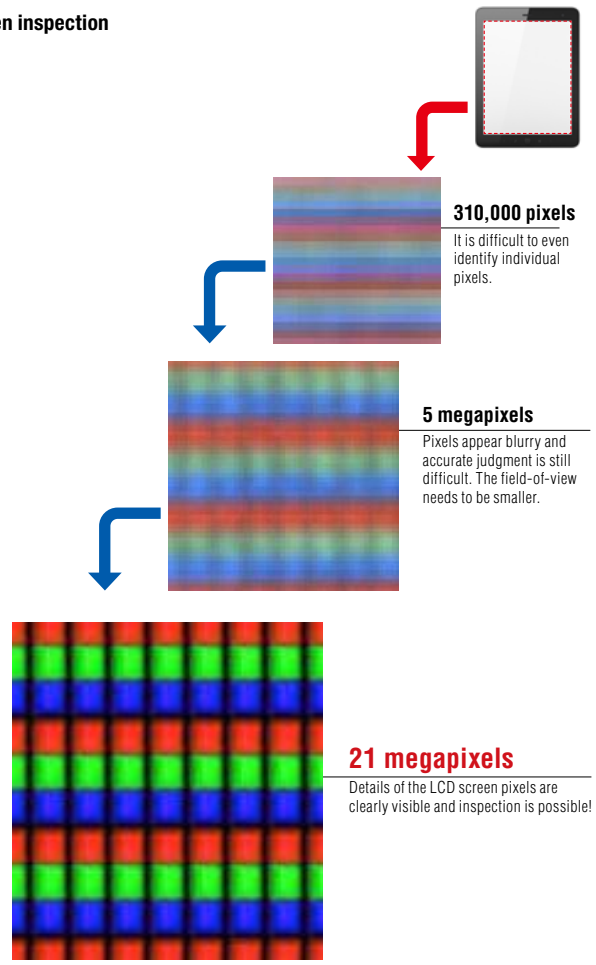
21 MEGAPIXEL CAMERA ENABLES A WIDER RANGE OF INSPECTION AT HIGHER ACCURACY



A 21 megapixel image, with a resolution of 5104 x 4092, can be captured at a rate of 9 FPS (110 ms).
This allows minute detection of defects in a wide field-of-view, which was impossible with lower resolution cameras.

High accuracy inspection with a single camera

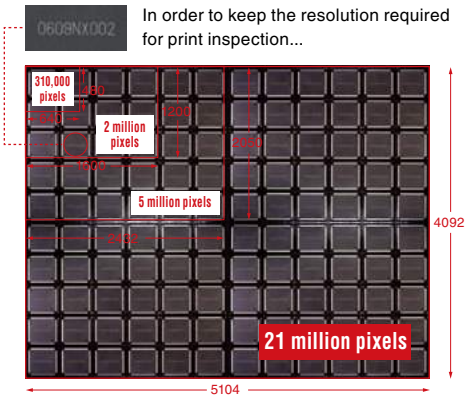
LCD screen inspection



Inspect a larger field-of-view

Inspection of IC printing on a tray

With 21 megapixel image processing, inspection of a large field-of-view can be completed at once while keeping the required resolution.



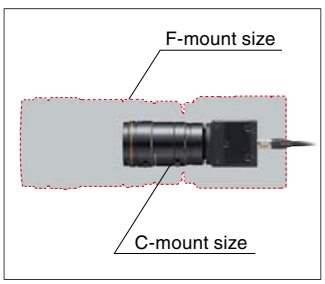
Two-camera connection for processing 42 megapixels at once

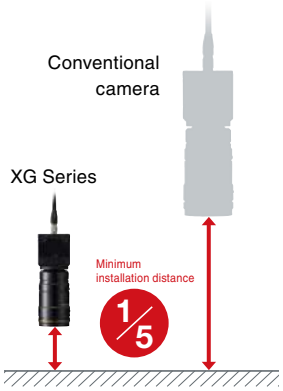
Connecting two 21 megapixel cameras allows processing of up to 42 million pixels. The two cameras can capture and transfer images simultaneously.



4/3" CMOS SENSOR, C-MOUNT LENS SUPPORT

A high-sensitivity, compact 4/3" CMOS sensor is used in the 21 megapixel camera.
This allows the use of C-mount lenses designed for 4/3" sensors, resulting in a wider range of lens selection.
Installation flexibility is greatly improved compared to conventional systems.





Support for C-mount lenses allows for the use of lenses with short focal lengths. The minimum installation distance is reduced to approximately 1/5.

EXAMPLE

Comparison of the WD required for a field-of-view of 100 mm 3.94"

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LINE SCAN CAMERA OPTIONS

The XG-8502L/8702L/8802L vision systems offer line scan camera connectivity giving an extra level of image processing to the XG Series. The XG-8000 Series removes the complexities of compiling an image with a line scan camera through the easy connectivity and option driven interface. This enables line scan technology to be taken full advantage of, while driving down the time, effort and difficulty required to implement.



Model	XG-HL02M
Applicable lens	1" C-mount
Number of pixels	2048
Max. expanded image size	2048 × 16384
Scan speed	24 µS/line
Pixel clock	100 MHz (8x transfer)



Model	XG-HL04M
Applicable lens	1" C-mount
Number of pixels	4096
Max. expanded image size	4096 × 16384
Scan speed	24 µS/line
Pixel clock	200 MHz (16x transfer)



Model	XG-HL08M
Applicable lens	2" (M40 P0.75) lens*
Number of pixels	8192
Max. expanded image size	8192 × 8192
Scan speed	45 µS/line
Pixel clock	200 MHz (16x transfer)

*Supports F-mount conversion adapter

HIGHLY FLEXIBLE IMAGE PROCESSING SYSTEM WITH SIMPLE SETUP & USAGE

The XG-8000 Series makes using or incorporating a line scan camera into an existing setup very easy. The XG method eliminates the need for conventional, complex, and specialized PC based line scan systems that require multiple parts from different vendors. In addition, the interchangeable camera module makes combining technologies onto one platform very simple and hassle free.

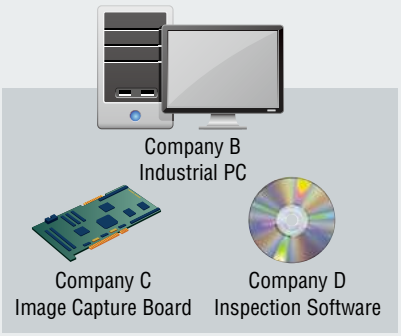
XG LINE SCAN SYSTEM





CONVENTIONAL LINE SCAN SYSTEM





XG SERIES FEATURES

- Compatibility issues are eliminated since all the hardware is from the same manufacturer.
- Simple connection of the camera to the controller allowing the user to obtain images quickly.
- Robust solid state hardware design.
- Minimal programming knowledge required.

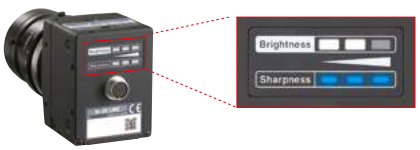
CONVENTIONAL PROBLEMS

- Compatibility issues arise due to connecting multiple devices from different manufacturers.
- A great amount of time and effort is needed in order to capture good images.
- Concerns with freezing or crashes due to the PC-based design.
- Specialized programming knowledge is typically necessary.

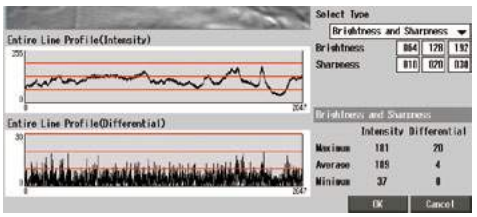
EASY SETUP CONFIRMATION WITH LED INDICATORS FOR BRIGHTNESS & SHARPNESS

INDUSTRY FIRST

The typically difficult task of obtaining the correct camera mounting is made easy using visual LED indicators right on the camera that show the level of light intensity and sharpness being received. This drastically reduces the amount of time needed for line scan camera installation.



LED indicators on the back of the camera display the focus and intensity information of the image currently being captured using a 3-level indicator. The individual threshold levels can be user specified in order to obtain the best results under the specific application conditions.

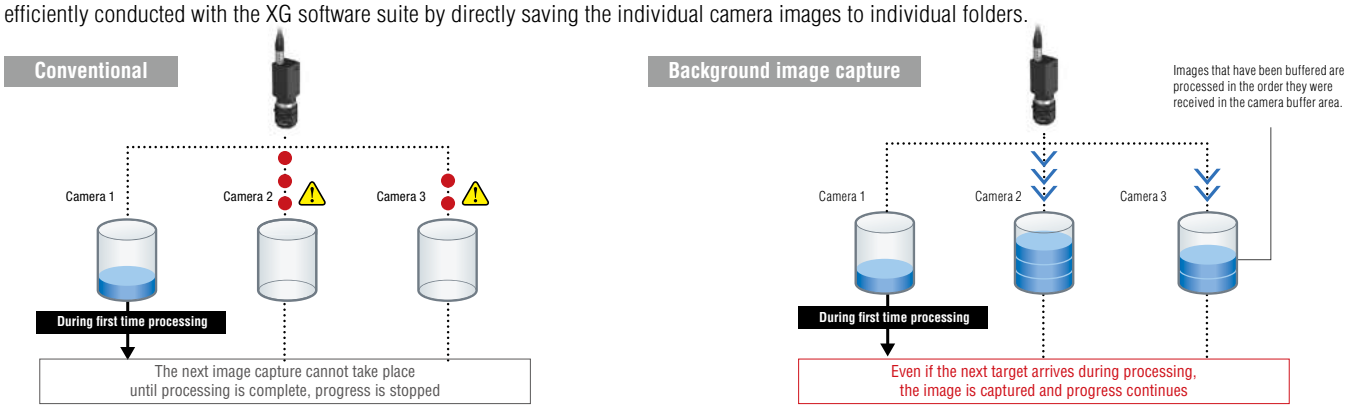


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INDEPENDENT IMAGE CAPTURE

Capture images out of sync based on physical machine processes and device interaction

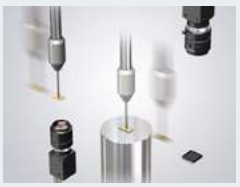
The XG Series is capable of independent image capturing so that it captures images during the flow of operation rather than at the beginning of the sequence. Images can be captured in sync with device movements and with no dependence on the current image processing being conducted. Conventional systems have to wait for the return of a program to the beginning of its cycle for a new image to be obtained. This function captures images and places them in the buffer if the XG controller is currently processing another image. Up to 1013 images can be stored in the buffer helping enable a zero image processing delay period to maintain a high throughput during processing. PC simulations can also be efficiently conducted with the XG software suite by directly saving the individual camera images to individual folders.



EXAMPLE

Non-synchronous image capture for high-speed pick & place processing

As it is possible to send a trigger input from the machine to the XG controller in sequence with the index and transfer operation so the cycle time can be dramatically improved.



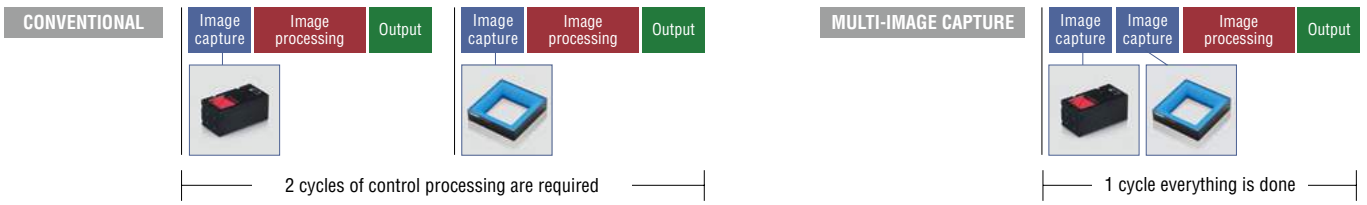
CONVENTIONAL MODEL — The operation timing has to be synchronized by lengthening the stop time of the index, or two separate controllers needed to be used.

INDEPENDENT IMAGE CAPTURE — There is no need to stop the index cycle as the single controller can capture both images with no waiting period.

UNSURPASSED MULTI-IMAGE CAPTURE

Optimization of a single inspection cycle.
Conventional systems rely on the completion of the process before acquiring the next image

In conventional image processing, one inspection cycle consists of “image capture → inspection → output”. If multiple inspection is required on the same target but under different lighting conditions, this cycle would have to be repeated multiple times. However, in the XG Series, a secondary image capture can be performed straight away (after the first and before any processing starts), the lost time associated with the additional unnecessary trigger inputs, and outputs can be eliminated.



EXAMPLE

Defect inspection with multiple lighting

Using the XG multi-image capture capability allows the detection of defects and quality control that is not possible with conventional image processing.



Halation elimination due to multiple image capture

Using multiple light sources and the image calculation function means the perfect image can be obtained in one cycle, even if different lighting combinations need to be put together. In a conventional system 3 or more cycles would need to be performed to get all of the images severely impacting on the machines cycle time. Even then the system may not be able to process the images and inspection correctly.



Multiple image capture increasing light intensity

Composite image via image calculation function



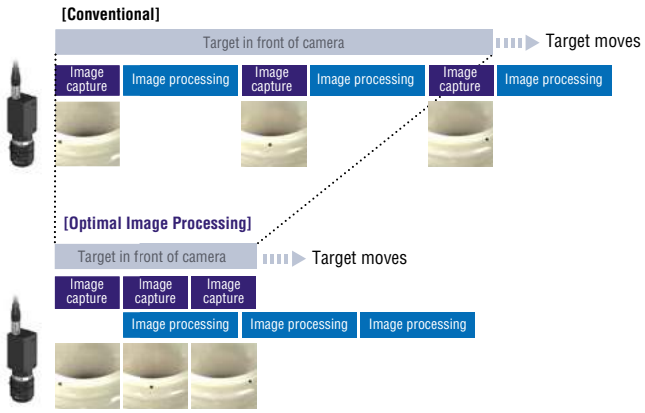
Resultant image used for inspection with no over or under exposure.

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OPTIMAL IMAGE PROCESSING

PERFORM INSPECTIONS WHILE ALSO CAPTURING IMAGES AT HIGH SPEED IDEAL FOR COMPLETE INSPECTION OF A SINGLE PART WITHOUT COMPROMISING PRODUCT HANDLING

Images can be captured at high speeds and stored in the buffer while previously captured images are simultaneously processed in the flowchart for optimal processing performance. This reduces the time for which a workpiece has to be stationary as well as product handling concerns that until now would have to be addressed due to the alternation between image capture and processing.



APPLICATION

Inspecting the full circumference of the mouth of a PET bottle

The application requires for the total circumference to be inspected when rotating at high speeds. The XG Series image buffer and processing design allows for buffered images to be processed even after the target has moved on.

CONVENTIONAL

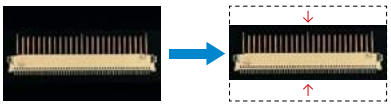
The inspection consists of repeating "image capture→ inspection→ output", which takes significant time for a complete inspection. As a result the full inspection can only be performed at low rotation speeds.

OPTIMAL IMAGE PROCESSING

As image capture is continually happening at the fastest speed, the inspection can be performed without lowering the rotation speed. When using a high-speed (16x) camera even greater than anticipated performance can also be achieved.

Optimal performance is achievable by buffering up to **1024** images at a transfer time of **1.7** ms.

OPTIMIZING IMAGE CAPTURE



Partial image capture

Capturing only the necessary image data makes it possible to significantly reduce image transfer time.



Sensitivity adjustment function

The sensitivity of the camera CCD can be adjusted through 81 levels enabling good quality images to be captured at high shutter speeds.



RGB span/shift function

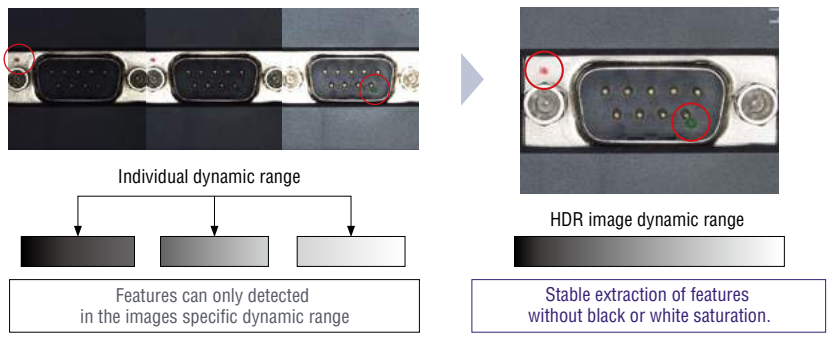
To enhance shade differences on low contrasting targets, the individual RGB levels can be shifted for stable performance.

HDR

AUTOMATIC HDR IMAGE CREATION

Shiny metal parts and unevenly lit targets can make inspections difficult and unreliable. With High Dynamic Range (HDR), these problems can be eliminated. HDR images better represent what your eyes see to emphasize details that lighting and lensing techniques cannot achieve alone. Subsequently, HDR makes it easy to capture a high quality image for unsurpassed inspection performance.

HDR Process (automatic adjustment of the shutter speed for multi-image capture)



Features can only detected in the images specific dynamic range

Stable extraction of features without black or white saturation.

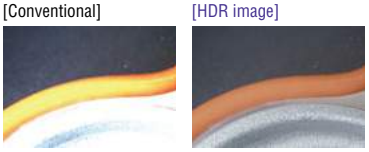
Halation canceling

[Conventional] [HDR image]



Light fluctuation

[Conventional] [HDR image]



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CONTROLLER ARCHITECHURE

Dedicated hardware with parallel processing ensures unbeatable performance and reliability

STABLE, RELIABLE PERFORMANCE

KEYENCE has continued to place an importance on stand-alone type image processing systems with incredible reliability. The hardware of KEYENCE vision systems regularly offer high-performance even under harsh environments. The final product is an extremely stable machine vision system that can be used with peace of mind.

THE CONCEPT OF THE XG SERIES HARDWARE



Tough hardware that can endure continuous operation

Mechanical components such as HDDs and cooling fans have been eliminated to minimize internal failures.

Quick restoration

Each key component of the system can be easily replaced. Even the programs are stored on an SD card, so in the event of a controller breakdown the SD card and program can be swapped out to a new controller in minutes.

Plug and play compatibility

All components including peripherals for the XG Series offer full compatibility at the highest performance.

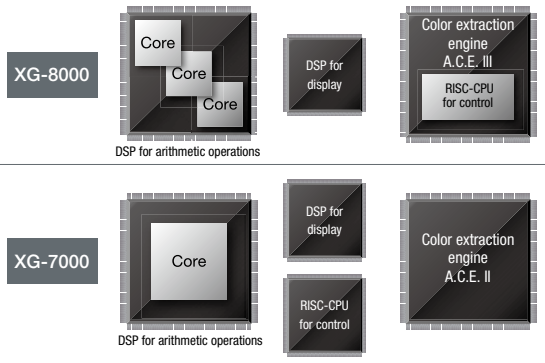
Parallel processing offers higher performance

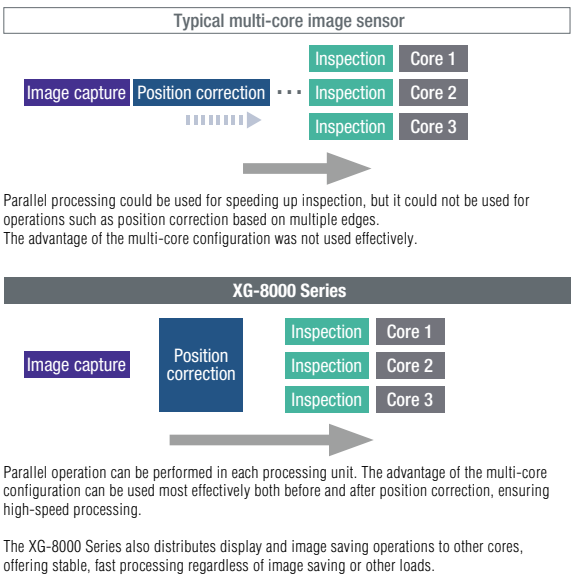
The 3 + 1 and multi-core processor performs simultaneous parallel processing of image processing, display, and communication.

TAKING FULL ADVANTAGE OF THE MULTI-CORE CONFIGURATION TO ACHIEVE THE FASTEST PROCESSING INDEPENDENT OF CONDITIONS

XG-8000 Series upgraded for even faster processing

The triple-core main DSP has been upgraded to achieve even faster processing. With typical multi-core image processing, parallel processing was restricted by various conditions. With the XG-8000 Series, each processing unit is capable of distributed parallel operation, resulting in faster processing independent of conditions. Such ultimate high-speed performance enables high-load processing using a high-pixel camera as well as operation that requires fast cycle times.





Parallel processing could be used for speeding up inspection, but it could not be used for operations such as position correction based on multiple edges.
The advantage of the multi-core configuration was not used effectively.

Parallel operation can be performed in each processing unit. The advantage of the multi-core configuration can be used most effectively both before and after position correction, ensuring high-speed processing.

The XG-8000 Series also distributes display and image saving operations to other cores, offering stable, fast processing regardless of image saving or other loads.

HIGHLY RELIABLE FAN-LESS/HDD-LESS DESIGN

Fans and conventional HDDs have moving components that will eventually wear out. By not having moving components, long-term continuous reliable operation is possible. The XG Series has sophisticated heat dissipation technology allowing for a fan-less design even while putting heavy loads on processors running at high speeds. In addition, this design is particle emission-free and therefore suitable for use in clean-room environments.



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CONTROLLER OPTIONS

From the single-core XG-7002 to the triple-core, 8 camera XG-8802L, the wide range of flexibility and same easy to use interface of the XG Series means there is a controller for every application.

		AREA CAMERA MODEL							LINE SCAN CAMERA MODEL		
		XG-7000 Series			XG-8000 Series						
											
Model		XG-7002(A)	XG-7502	XG-7702	XG-8002	XG-8502	XG-8702	XG-8802	XG-8502L	XG-8702L	XG-8802L
DSP		Single-core 	Single-core (High-speed type) 		Multi-core 	Multi-core (High-speed type) 					
Supported cameras	XG-(H)035x XG-S035x	✓	✓	✓	✓	✓	✓	✓ *1	✓	✓	✓ *1
	XG-(H)200x XG-S200x	—	✓	✓	—	✓	✓	✓ *1	✓	✓	✓ *1
	XG-H500x	—	—	✓	—	—	✓	✓ *1	—	✓	✓ *1
	CA-HX048x	✓ *2	✓ *2	✓ *2	✓	✓	✓	—	✓	✓	—
	CA-HX200x	—	✓ *2	✓ *2	—	✓	✓	—	✓	✓	—
	CA-HX500x	—	—	✓ *2	—	—	✓ *2	—	—	✓	—
	CA-H2100x	—	—	—	—	—	—	—	—	✓	—
	XG-HL02M	—	—	—	—	—	—	—	✓	✓	✓ *1
	XG-HL04M XG-HL08M	—	—	—	—	—	—	—	—	✓	—
Display/ Touch panel	Dedicated touch panel (RS-232C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Output resolution	 SVGA 800 × 600			 SVGA 800 × 600 or  XGA 1024 × 768						

*1 Check the specifications sheet at the end for information on camera types or connection conditions that support the XG-8802(L). *2 The LumiTrax function is not supported.

EXPANDABLE PLATFORM INDUSTRY FIRST

By connecting additional modules to the side of the controller, the optimum system can be setup as well as allowing future expansion when needed.





Light control expansion module

Main controller

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EXPANDABLE CONTROLLER

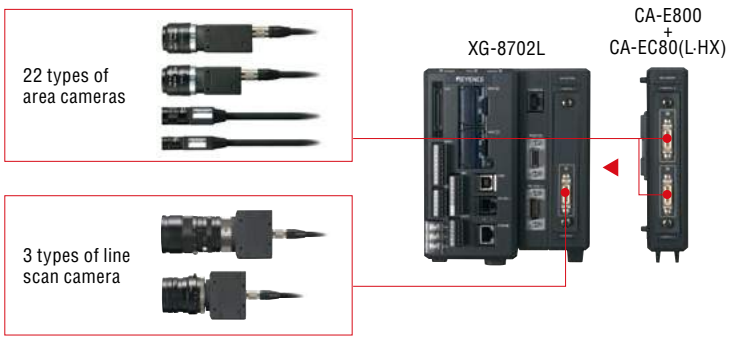
Flexible expandable hardware

MULTI-CAMERA, SIMULTANEOUS ACQUISITION SYSTEM

The XG-8000 Series offers the choice of up to 22 types of area cameras and 3 types of line scan cameras.* This allows the same XG programming interface to be used no matter which camera is connected and provides the flexibility to easily adapt to changes that may occur with the inspection criteria.

*Some combination may not be possible. Contact us for details.

MULTI-CAMERA SYSTEM EXAMPLE: XG-8702L



*The 5MP area type camera is compatible with the XG-8702L controller only. (Used with XG-EC80 camera input unit connected)

*The XG-HL04M/08M are compatible with the XG-8702L controller only. (Used with the XG-EC80L camera input unit connected)

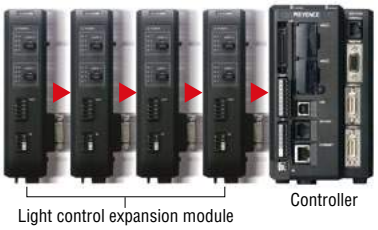
DIFFERENT CAMERA COMBINATION EXAMPLE



The entire circumference of the cylinder side is captured into a single image using the line scan camera while it is rotated. The top surface is captured with an area scan camera and the entire workpiece is inspected in one cycle. The combination of two different types of cameras results in reduced inspection times and cost.

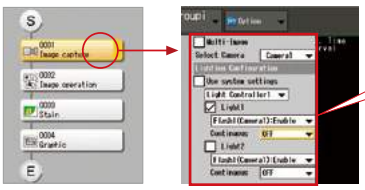
LED LIGHT CONTROL EXPANSION UNIT Easily control dedicated lighting without any extra wiring WORLD'S FIRST

Up to 4 lighting expansion modules can be connected to the main controller.
Each unit has 2 lighting connections (connector and terminal style)
so up to eight 12 or 24 VDC lights can be connected.



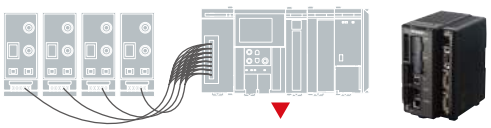
Light settings

Lighting can be easily controlled as part of the image processing flowchart by setting the lighting conditions in the light settings tab within the image capture unit. By using multiple image capture units with different lighting patterns or intensities within a single processing flowchart, multiple image capture and advanced light sequencing is made easy. In addition, as the light intensity value is a variable that can be referenced, dynamic changes can be made to a program after an inspection has been processed.



The ON/OFF status, strobing and intensity of 8 lights is possible in each image capture unit.

Conventional methods require PLC control with large numbers of I/O.



No I/O allocation, no wiring and no PLC programming is necessary



TOUCH SCREEN GESTURES

The touch panel display allows for intuitive multi-touch operations on site. Areas of interest (such as a defect) can be scrolled to and magnified on the display with the touch of a finger.



Using a single finger the image can be scrolled about the screen.



The image displayed can be magnified by pinching in or out with two fingers.

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PREPROCESSING FILTERS

HIGHLIGHT AND IMPROVE FEATURES THAT PREVIOUSLY COULD NOT BE SEEN. REMOVE FEATURES AND ASPECTS OF AN IMAGE FOR STABLE INSPECTION.

The XG Series includes 24 types of preprocessing image enhancement filters that can dramatically improve the raw camera image based on changes that are caused from differences in the target or the targets environment. In using these original KEYENCE filters correctly, an optimal image for processing can be created resulting in an improvement in inspection stability and performance. This can help reduce mis-detection and inspection errors and give a high level of confidence to using machine vision.

Shading Correction (Real Time)

Shading correction is a real time filter that evens out any large random shadows or glare on a target surface, leaving behind smaller defined points which are often associated to being flaws or defects. As this is a gray scale processing filter, it dynamically changes the processed image based on the input image rather than being based on a fixed binary setting level. This ensures consistency with target variation and changes in the raw image.

■ Surface quality on a metal roller



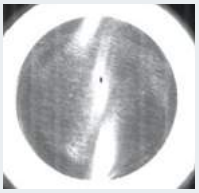
Original image



After preprocessing

Shading correction can be used to extract just bright, dark or both bright and dark defects depending on the nature of the surface and image needing to be created.

■ Stain detection on the bottom of a can



Original image



After preprocessing

By cancelling out the hot-spots caused by changes in the target surface a uniform background with the strain present can be created.

Scratch Defect Extraction

Eliminates noise information within the inspection region and only highlights linear information. This filter is particularly effective for linear defect inspection for workpieces having rough surface conditions.

■ Linear stain on a metal component



Original image



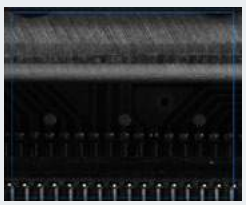
After preprocessing

Only linear stains are extracted by ignoring background noise.

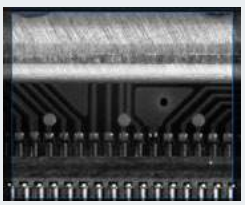
Contrast Expansion

Expands the intensity distribution within the inspection region to increase the contrast of an image. This filter stabilizes inspection when gradation necessary for image processing cannot be obtained due to the reflectance of workpieces.

■ Various circuit board pattern inspections



Original image



After preprocessing

The circuit board pattern can be recognized clearly.
Because the filter determines the expansion width from the intensity distribution within the inspection region, images without overexposure and underexposure can be captured.

Noise Isolation

Eliminates or extracts noise having a specified area or smaller. This filter is effective when a rough background hinders image processing or to detect subtle stains.

■ Recognition of characters printed on cardboard



Original image



After preprocessing

Only bright and dark noise are removed and the printing condition remains unaffected.

■ Stain inspection for a plastic mold



Original image



After preprocessing

Only black stains smaller than the specified area are extracted.

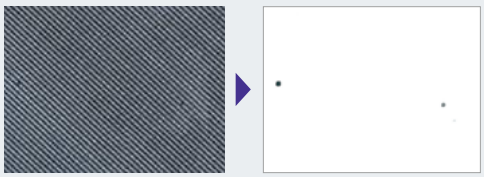
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IMAGE OPTIMIZATION

Bidirectional Smoothing (Blur)

Has an effect that removes a significant amount of fine background patterns or noise.
This filter can be set to have an effect that performs smoothing in individual directions (X/Y), thus making it applicable for a wide range of applications, including counting individual items.

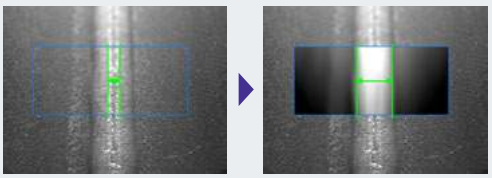
■ Foreign particle detection on a striped pattern



Original image | After preprocessing

By eliminating the striped texture to the target, foreign particles can be detected.

■ Width inspection for a welded pipe section



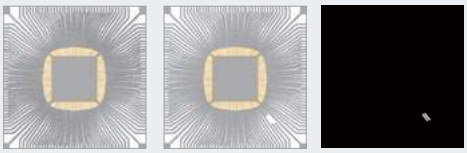
Original image | After preprocessing

The blur filter allows a stable width measurement by eliminating unnecessary featured points other than the welded section.

Subtraction

Produces the difference from two images by subtracting the input image from the master (registered image).

■ Lead frame chip inspection



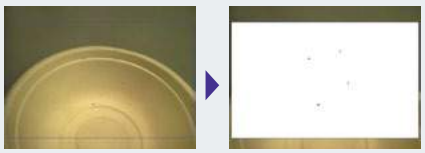
Registered image (good part) | Input image (defect) | Differential image

As a true subtraction is performed even complex targets with defects can be easily processed as the difference is left over on a uniform background.

Real-time Image Extraction

As this filter processes in real time on the acquired image only, the part movement doesn't affect the image used for defect inspection. The filter extracts the small areas of change (such as stains and defects) in the image, whereas the larger and uniform areas (such as the edge lines and background) are removed. Leaving a stable image for stain detection.

■ Foreign particle inspection inside a cup



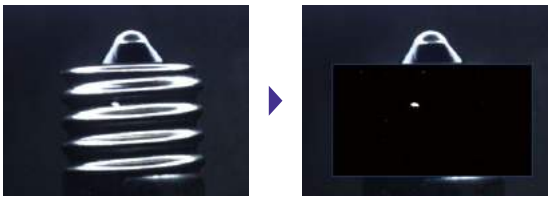
Original image | After preprocessing

As part position is not always repeatable so stable defect detection is still possible as the edge line, border and background are removed from the initial raw acquired image.

Individual filter processing direction

The versatility in being able to choose a filters processing direction realized with the blur filter is now available in the shading correction, image extraction, expand, and shrink filters. Being able to choose the processing direction helps make the most of applying the image enhancement filter according to how a target or feature appears.

■ Individual filter processing direction



Original image | After preprocessing

[Filter used: Shading correction] Processing direction: X
The defective area is isolated by removing the directional shading on the thread.

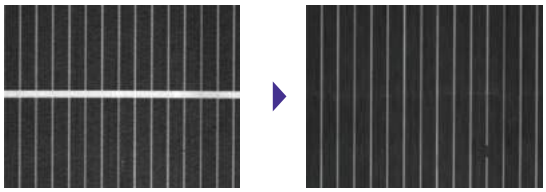
■ Foreign material detection on a lattice pattern



Original image | After preprocessing

[Filter used: Image extraction]
Processing direction: X -> Processing direction: Y
The background lattice pattern is removed by applying the filter multiple times while changing the processing direction.

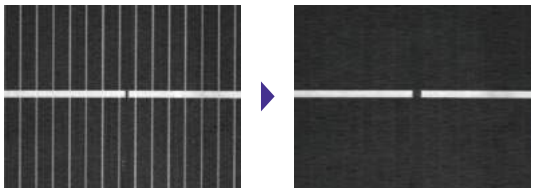
■ Inspection of grid lines on a solar cell



Original image | After preprocessing

[Filter used: Shrink] Processing direction: Y
The break is enhanced while the width of the grid lines remain and the bus bar is removed for stable inspection.

■ Inspection of bus bars on a solar cell



Original image | After preprocessing

[Filter used: Shrink] Processing direction: X
The grid lines on the background are removed by shrinking the image in the X direction broadening the break in the bus bar.

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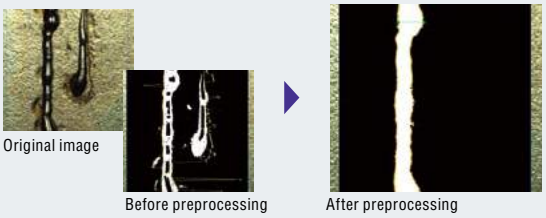
INDUSTRY FIRST

BLOB FILTER

Blob filtering of certain grouped image elements based on attributes (surface area, shape size etc.), enables only the desired areas to be processed.

Width measurement of a welded section

Measuring the width of a weld after cancelling shadows, dents and removing spatter & excess from the weld section.



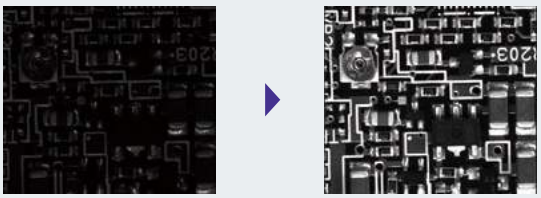
Original image | Before preprocessing | After preprocessing

CONTRAST CONVERSION

The Contrast Conversion filter helps enhance contrast by emphasizing or reducing ranges of gray scale without causing shadows or overexposure. This helps increase edge strength, unify levels of gray or reduce noise on an image.

Defining PCB components and connections

By increasing the difference between the board and mounted components the areas for inspection are easily highlighted.



Original image | After preprocessing

PRESERVE INTENSITY

Illumination compensation

The Preserve Intensity filter automatically corrects for any intensity changes in the image due to light deterioration or external lighting fluctuations. The level of intensity in the captured image is compared to a pre-determined standard on a reference image and the difference is applied before processing.

Screw position inspection



Original image (normal light intensity) | Binary image | Original image (lowered light intensity) | Binary image No preserve intensity | Binary image With preserve intensity

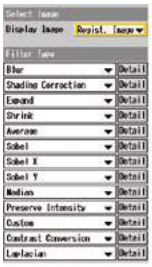
For each inspection unit, you can combine filters creating optimal images for an inspection

Multiple processing

A total of 24 types of preprocessing filters can be set and each filter can be processed up to 13 times per unit. For each unit, filters can be combined together in the optimal combination for that single inspection.

Filter order and sequencing

The preprocessing sequence can be easily changed by moving filters up and down the list.



On-screen effects and results

Preprocessing results are displayed in real-time on the screen. Making it quick and easy to see and set the optimal combination in the minimal time.



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COLOR PROCESSING

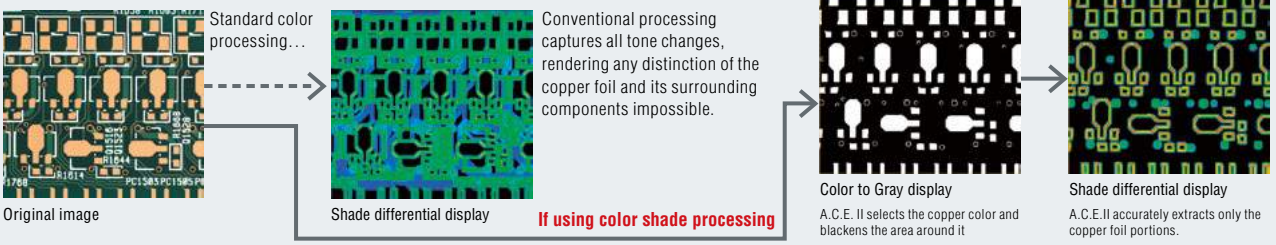
Optimal color processing for stable inspections using the new color extraction engine A.C.E.II

The XG Series is equipped with a new color extraction engine. The A.C.E.II is based on the HSB color model (closest color model to the human sensory system) to attain high color extraction performance that stabilizes previously unstable color processing schemes. The XG Series also feature fine color processing to extract full color information exactly the way the camera captures it. This technology significantly broadens the range of color processing applications previously accomplished by machine vision systems.

COLOR TO GRAY PROCESSING

Color to Gray processing can optimize the shade gradation using hue, saturation, and brightness. This makes it possible to convert images with low contrast into images with defined shade differences. Unlike conventional full color processing, which picks up all tone changes and makes distinction difficult, color shade processing can optimize the shade difference between a user-specified color and the background.

Extraction of copper foil on printed circuit boards



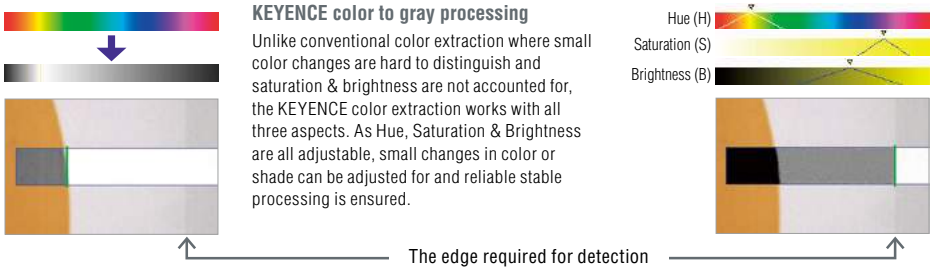
KEYENCE's original color shade processing

Standard color shade processing

This process converts all colors to a certain level of gray. Making similar or close colors hard to differentiate between, as well as not accounting for saturation and brightness levels and potential changes.

KEYENCE color to gray processing

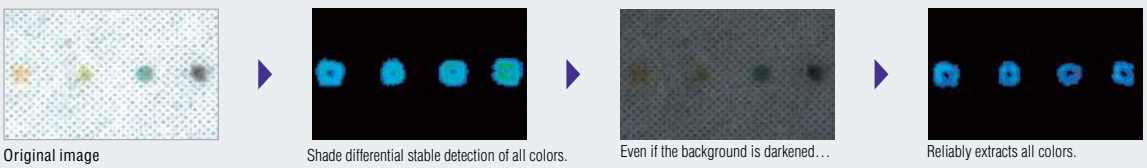
Unlike conventional color extraction where small color changes are hard to distinguish and saturation & brightness are not accounted for, the KEYENCE color extraction works with all three aspects. As Hue, Saturation & Brightness are all adjustable, small changes in color or shade can be adjusted for and reliable stable processing is ensured.



FINE COLOR PROCESSING

Fine color processing directly processes full color information exactly as the color camera captures it. This is ideal for detecting stains on sheets, films and non-woven cloths where the stain can appear in any color with respect to the background. No setup is required for color extraction, allowing users to complete the inspection with one simple operation.

Foreign particle detection on a non-woven cloth



Overcoming the weaknesses of full color processing

Intensity cancellation function (glare removal)

The newly added intensity cancellation function solves a common problem of detecting all the changes when using full color processing on color images. This function delivers stable detection performance by ignoring glare and lighting variations on the target background, and detecting only the area where hue and saturation differences exist.



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IMAGE OPERATION FUNCTION

Create a single image from multiple images through a host of advanced image combining functions

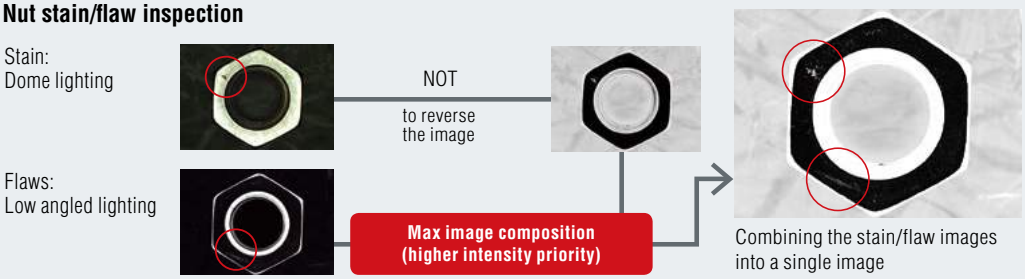
The XG Series has a multitude of image operation functions, including mathematical (addition, subtraction, multiplication, division), logical operations, bit calculations, rotating/parallel translations, zoom, trapezoidal correction and pixel number conversion. Being able to combine multiple images into one resolves a number of issues that have made some conventional inspections difficult.

IMAGE CALCULATION EXAMPLE 1

MULTI-LIGHTING & IMAGE COMPOSITION

Even with defects on the same target, optimal lighting can differ for different cases of flaws (projections/depressions) and stains (shade intensity). Although two image captures and two different lighting techniques are used for individual defect inspection of the target. The combination of the two images and defects can be put together to be processed and displayed together.

Nut stain/flaw inspection



CONVENTIONALLY

As the two defect inspections have to be separated due to the need for different lighting so the total number of defects, total defect size or overall target pass/fail cannot be easily put together for a single target.

IMAGE CALCULATION

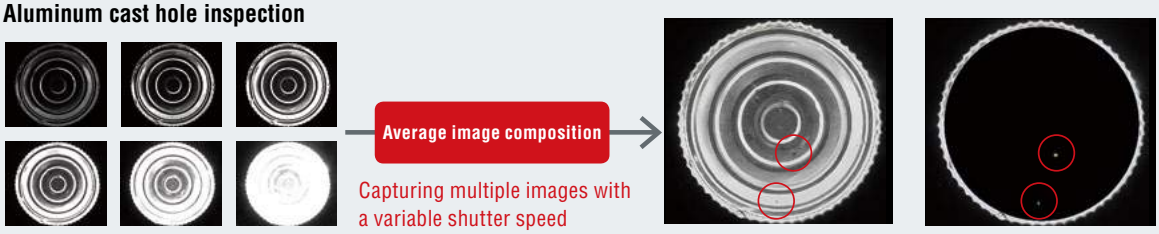
Judgments can now be conducted to the same standard as inspections previously implemented visually, including the area judgment of total stains or flaw.

IMAGE CALCULATION EXAMPLE 2

CHANGING LIGHT INTENSITY & IMAGE COMPOSITION

Targets can often have different types of defects requiring different lighting methods for stable detection (e.g. scratches/burrs and surface stains). The flexibility of the XG means multiple lighting patterns can be cycled through and tools applied ensuring correct inspection of the part. At the same time the image operation function enables composite images to be created so all the detected defects can be shown on screen and processed at once per inspection.

Aluminum cast hole inspection



Acquisition of a uniform image without the dark or bright defects being lost.

Stable detection of defects using preprocessing filters and the stain inspection tool.

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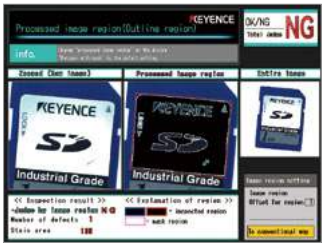
IMAGE OPTIMIZATION

PROCESSED IMAGE REGION FUNCTION

FIRST IN ITS CLASS

Map the inspection region to the ever changing target image or setup complex fixed inspection regions

The XG gives a wide range of image inspection region options. Simple (rectangle, circles, arcs etc.) and complex shapes (multi-node, multi-region) can be easily drawn on the image. Additionally, a region can be designated and mapped to the binary boundaries of an image for ever changing target shape and size inspections. The vision inspection region can adjust for geometric shapes like circles and straight lines or more complex contours such as ovals or free-from curves.



Stain detection on a plastic mold

Automatic inspection region adjustment on complex shapes based on their binary image. Enabling stable detection on any target even without position adjustment.



CALIBRATION FUNCTION



Image calibration including tilt, and lens distortion correction

The XG removes conventional image processing problems caused by camera mounting angle and lens distortion. The camera can be calibrated precisely, orientated about its axis and have its origin offset from its location for true measurement, scaling and position processing.

TILT CORRECTION

The calibration function corrects for the camera angle that occurs during mounting. Unlike trapezoidal correction, this accurately corrects the entire image by making use of numerous calibration patterns across its field-of-view. This resultant normalized image is also effective for image processing when forced to mount the camera at an angle due to space restrictions.

Location and inspection of disk marks

Resolves the problem of differing target shapes and orientations during part/feature searches.



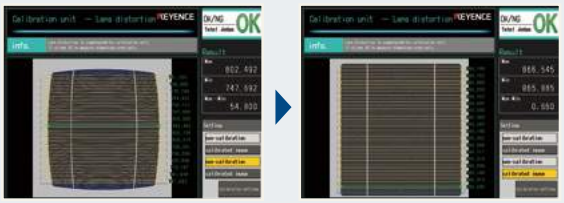
Original image | Calibrated image

LENS DISTORTION CORRECTION

The calibration function also corrects for lens distortion. A uniform image can be acquired on the entire screen, allowing for accurate dimensional measurements, positioning and part inspection to be achieved.

Width measurement of a solar battery cell

Resolves the problem of differing measurement results at the center and edges of the image area due to lens distortion.



Original image | Calibrated image

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IMAGE STITCHING

JOINS MULTIPLE CAPTURED IMAGES AND PERFORMS HIGH-RESOLUTION INSPECTION A STABLE INSPECTION WITH IMAGES OF GREATER ACCURACY

XG-8000 Series

Up to 4 images are joined together to generate a single stitched image*. By performing an inspection with stitched images, it is possible to achieve an inspection of greater accuracy and in a wider area. This is also effective in situations where one target is used in the images taken from multiple cameras.

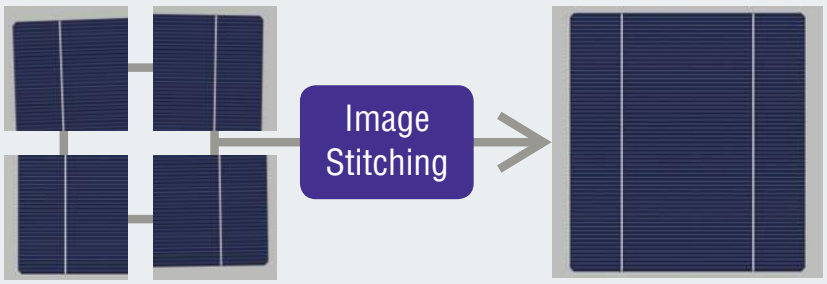
*Included with the XG-8702/XG-8702L only. It should be noted that this cannot be used with other controllers.

IMAGE STITCHING EXAMPLES

Image stitching using captured images from multiple cameras

By performing image stitching with images that have been captured with multiple cameras, it is possible to generate an image that appears to have been captured with a single camera. An inspection can then be performed on this single image. By stitching together 4 images that have been captured with four 5 megapixel cameras, it is possible to inspect images that have a resolution of up to 20 megapixels.

High-resolution inspection with 4 × 5 megapixel camera units



CONVENTIONALLY

The areas around the boundaries of the camera are exempt from inspection or the inspection is performed after using multiple cameras and overlapping multiple images.

IMAGE CALCULATION

By preforming an inspection with a single image, it is possible to perform high-resolution inspection that is seamless and without overlap

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PROGRAM CREATION

Easy program development through flowchart based processing

VISION TOOLSET

The XG Series contains a wide range of vision tools for a variety of applications. From defect detection to barcode reading, the extensive vision toolset gives the XG Series the power to solve any application.

Area

The Area tool uses binary processing to detect either white or black pixels in a specified area. It will then count the pixels in this area and can use this measurement to perform presence/absence type applications.

Pattern Search

The Pattern Search tool looks for a specified target on the captured image. This can be used with other tools to find the pattern and adjust the position of those tools based on the pattern position. Limits can also be set based on count, position, and match percentage.

Edge Position

The Edge Position tool will find the location of edges within an inspection region. In this tool, the scan direction, edge direction, and maximum number of edges to count can be specified. This tool can count up to 3600 edges.

Edge Width

The Edge Width tool can find the distance between two edges using the same method of detection as the Edge Position tool. This tool has the ability to detect inner/outer gaps, or user specified gaps, and allows the user to set limits based on the distance between the two edges.

Edge Pitch

The Edge Pitch tool finds the maximum, minimum, and average distances between pairs of edges. It is able to measure the width of the gaps or the distances between the centers of the gaps. This tool is used to inspect for equal sizing or equal spacing over a range of parts.

Edge Angle

The Edge Angle tool can scan an image in a specified direction to locate two edges and find the angle formed by connecting the two edges. Once the angle is found, limits can be set and different parameters can be outputted, such as the edge positions and edge angle.

Edge Pairs

The Edge Pairs tool is essentially an advanced edge pitch tool. Unlike the Edge Pitch tool, the Edge Pairs tool can scan a target twice in a user specified direction. The double scan allows for a more stable inspection.

Stain

The Stain tool is a great tool for defect detection. It works by comparing adjacent groups of pixels to each other to look for relative contrast changes. When the contrast change is large enough, the tool will visualize it from a range of blue to red, where red is the greatest change in contrast.

Blob

The Blob tool uses binary processing to count groups of white or black pixels. An extensive Aspect Filter can be set to specify what kind of pixel groups you want to consider as Blobs. Limits can be set on the remaining blobs to perform a variety of inspections.

Trend Edge Position

The Trend Edge Position tool can locate the maximum and minimum positions across a length of an edge. This tool finds the profile of an edge across many points and outputs different positioning data. Not only can it find a point of a straight line, it can be used to find a circle center.

Trend Edge Width

The Trend Edge Width tool can measure the edge width across a length of an edge. Just like the Trend Edge Position tool, it locates the profile of an edge across many points to locate positions like the minimum and maximum edge width.

Trend Edge Stain

The Trend Edge Stain tool also extracts the profile of an edge across many points. Unlike the other Trend Edge tools, Trend Edge Stain looks for any deviations along the found edge. It is a powerful tool for locating imperfections like burrs, chips, flash, or short shots.

Intensity

The Intensity tool reports the grayscale intensity of a specified region of the image. It can be used for simple presence/absence applications or for the Preserve Intensity filter, which stabilizes the image brightness.

Color

The Color tool looks at a specified region of the image then reports back color information about that region. The color values can be reported as RGB (red, green, blue) or HSB (hue, saturation, brightness).

OCR

The Optical Character Recognition tool will readout and analyze character strings in the inspection region. This can be used for applications like lot code inspection and serial number checking. The internal calender can be referenced for limits and character encryption tables can be used.

2D Code Reader

A 2D barcode can be detected and analyzed. The result data can be split into 8 sections for easy management of the decoded information. Sorting type applications can be performed by matching the detected code to a string reference table. (QR, MicroQR, Datamatrix, Rectangular Datamatrix can be read.) It is also possible to verify the quality of printed information.

1D Code Reader

A 1D barcode can be detected and analyzed. The result data can be split into 8 sections for easy management of the decoded information. Sorting type applications can be performed by matching the detected code to a string reference table. (Code 39, Code 128, UPC/EAN/JAN, GS1 DataBar, ITF, Codabar(NW7), Pharmacode can be read.)

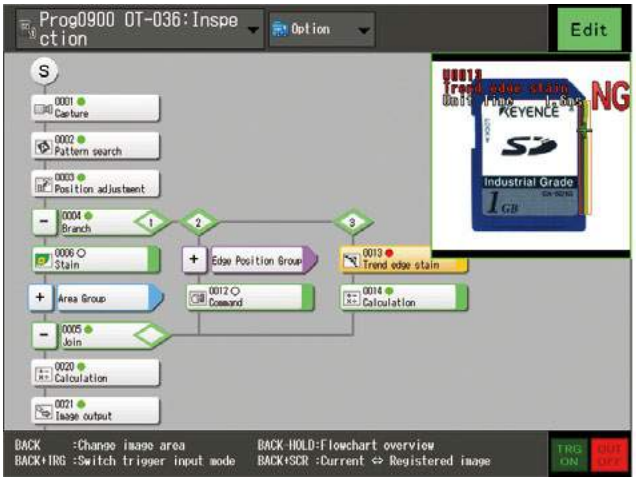
Characterization

Defect or target detection can be performed by comparing the detected intensity levels of groups of pixels to that of a base intensity. Light and dark targets can be differentiated as well as be categorized based off properties like area, volume, axis ratio, perimeter, and roundness.

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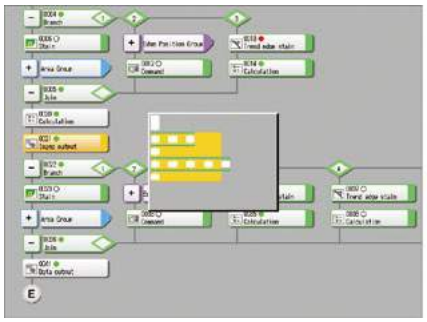
CONTROLLER FLOWCHART EDITING GIVES THE USER COMPLETE CONTROL

The controller supports direct interaction with the image processing flowchart without a PC. Enabling editing, addition, movement and configuration of different vision units with the handheld console. With the easy to navigate GUI, the time taken to make adjustments is kept to a minimum.



OVERALL FLOW CHART DISPLAY

The full flowchart can be displayed on screen for a full view of the operation. Navigation on large scale flowcharts is quick, easy and stress free as the area needing to be viewed can be selected from the map with the display cursor.



UNIT OPERATION & JUDGMENT DISPLAY

Each unit on the flowchart has an indicator to show whether it is being processed and its pass/fail status (OK/NG). This enables current state of the image processing flow to be easily checked at a glance.

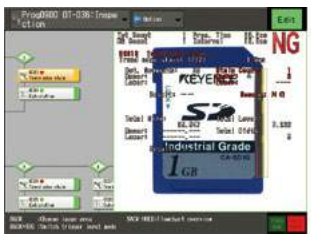


[Mark display]

- ● Unit processed, judgment - pass (OK)
- ● Unit processed, judgment - fail (NG)
- ○ Unit not processed

UNIT DIRECT VIEW

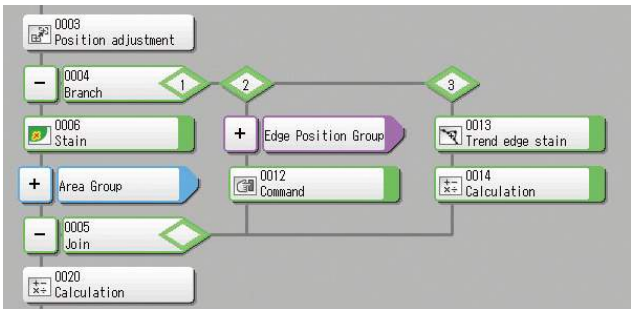
The detailed results and settings of a unit can be verified simply by placing the cursor over the relevant unit on the flowchart. Display unit results, show calculation terms, and the individual unit processing time





CONDITIONAL BRANCHING

The conditional branching used in an image processing flowchart can also be configured and displayed. Branches can be displayed in different colors and minimized to help with effective programming.

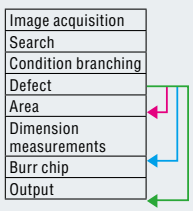


CONVENTIONAL MODEL

Conventional systems have a single flow structure. So a "jump to" command is required making navigation and understanding very hard.

REAL BRANCHING STRUCTURE

The XG's intuitive design shows the branches as physical divides allowing for easy understanding and navigation. Units can be simply inserted in the correct branch as required making setup changes quick and simple.



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DEFECT INSPECTION

Fast and easy implementation of complex vision algorithms with KEYENCE's original toolset

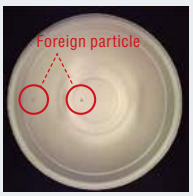
STAIN INSPECTION TOOL

A wide array of setting parameters and strong visualization tools makes this the industry standard in surface defect inspection.

The stain inspection tool finds defects such as stains and flaws by comparing the intensity of a user defined pixel grouping to that of its surroundings. For stable reliable inspections, stains can be grouped and filtered based on size, shape and contrast level. In addition the contrast view enables real time visualization on the performance of the tool to a user both during run and setup modes. Helping enable easy setup whilst maintaining consistent performance allowing for quick easy on machine tuning.

Foreign particle detection on the inside of a container

Conventional binary processing would not be able to detect the foreign particles as there is very little contrast between the particles and the dark portions of the container, however, stain inspection mode can compare the differences with the surroundings, allowing reliable detection of only the foreign particles.



Original image


Binary image


Stain inspection mode (stability screen)

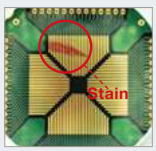
CONTRAST VIEW DISPLAY

Using the colors blue, light blue, green, yellow and red, the contrast view display assigns a color to defects according to the intensity difference between them and the surrounding area. The contrast view display updates in real time so you are able to see the defect position and intensity differences, allowing visual and intuitive confirmation of the differences between the defect you want to detect in comparison with the background or noise.

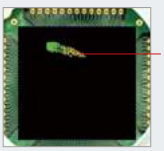
Bad mark detection on PCBs (Contrast view)

The contrast view can be used not only during setup, but also during operation. Leading to practical uses including the highlighting of potential areas of false detection and the verification of the current settings.

Original image



Contrast view display

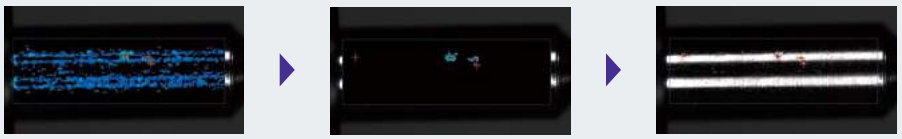


The area with an intensity difference is colored from blue to red.

The relationship between contrast view colors and the stain level (guideline)



Dent detection on a metal shaft surface



Initial confirmation there is a greater stain level for the dents and scratches (green & red) than the background

Visually adjusting the optimal parameters whilst using the contrast view display

Stable detection during processing

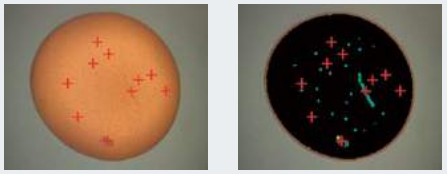
INDUSTRY FIRST

GROUPING FILTER

Various group filter settings are also available for the stain tool to enable processing and sorting of stains and defects. Filters include basic fill and area based functions as well as degree of circularity, major axes length, aspect ratios and axis ratios. Such settings support the filtering of defects for more efficient pass/fail and sorting applications based on defect size and shape.

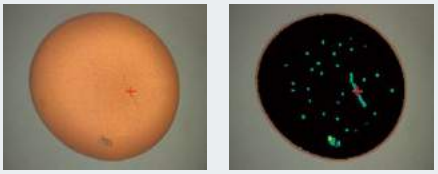
Crack detection of a tablet (before grouping filter)

The stain tool also picks out the granules and other changes that are of a similar stain level.



Crack detection of a tablet (after grouping filter)

Filtering of defects down to long thin cracks only using area and axis ratio.



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TREND EDGE STAIN INSPECTION TOOL

Optimized multi-point profile inspection for burr/chip applications

This tool extracts the profile from the edge of a target and uses it to recognize slight differences such as burrs and chips. In addition to simple geometric shapes such as circles and straight lines the tool can also be used on complex contours such as ovals, and continually adjusting free form curves.

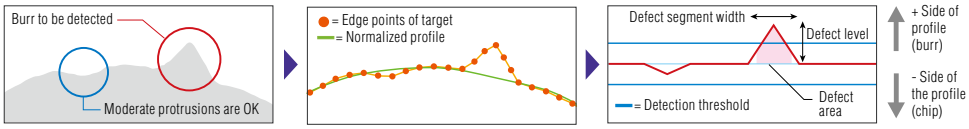
Loose Cable Winding Inspection

Even if the standard target shape changes from target to target during a process the free curve will still map the normal profile of the target. At the same time lots of individual edge points are detected ensuring the projection is recognized as well.



EXTENSIVE PARAMETER SETTINGS SUPPORT VARIOUS DEFECTS

Due to the wide range of parameters, it is possible to filter out defects based on inspection criteria.
Optimal settings can be chosen based on aspects such as +/- defects (burrs/chips), defect level, width and area.



CHARACTERIZATION TOOL **INDUSTRY FIRST**

EASILY DETECT & CLASSIFY TARGETS BASED ON GRAYSCALE INFORMATION

XG-8000 Series

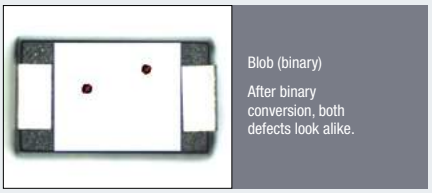
The characterization tool allows for targets to be identified and classified based on grayscale rather than binary data. This enables true characterization and filtering of detected targets based on true image data. Additional information for classifying and identifying defects that cannot be obtained through binarization such as volume and level of change is also possible with this new tool.

■ Differentiation of a variety of defects on a condenser

•Light & dark defects

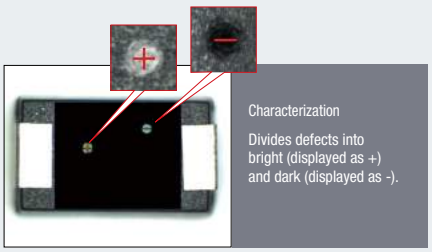


Sorting bright and dark defects.



Blob (binary)

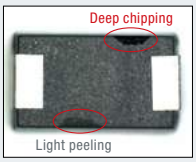
After binary conversion, both defects look alike.



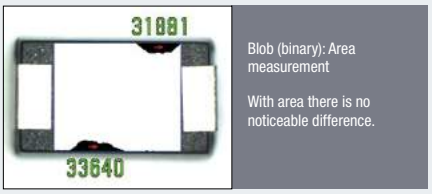
Characterization

Divides defects into bright (displayed as +) and dark (displayed as -).

•Shallow and deep defects

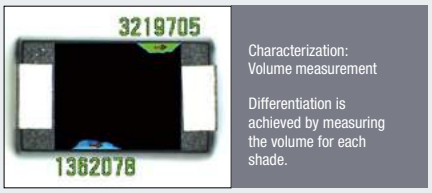


Differentiating between deep chipping and light peeling.



Blob (binary): Area measurement

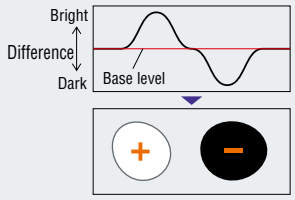
With area there is no noticeable difference.



Characterization: Volume measurement

Differentiation is achieved by measuring the volume for each shade.

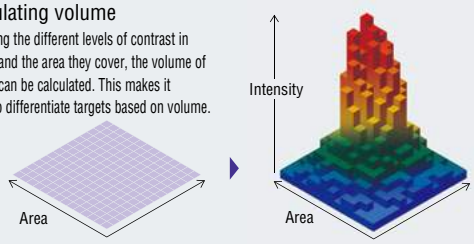
■ Sorting defects



The characterization tool uses a base reference value and the contrast of the defect to sort targets into bright and dark types.

■ Calculating volume

By detecting the different levels of contrast in the target and the area they cover, the volume of the target can be calculated. This makes it possible to differentiate targets based on volume.



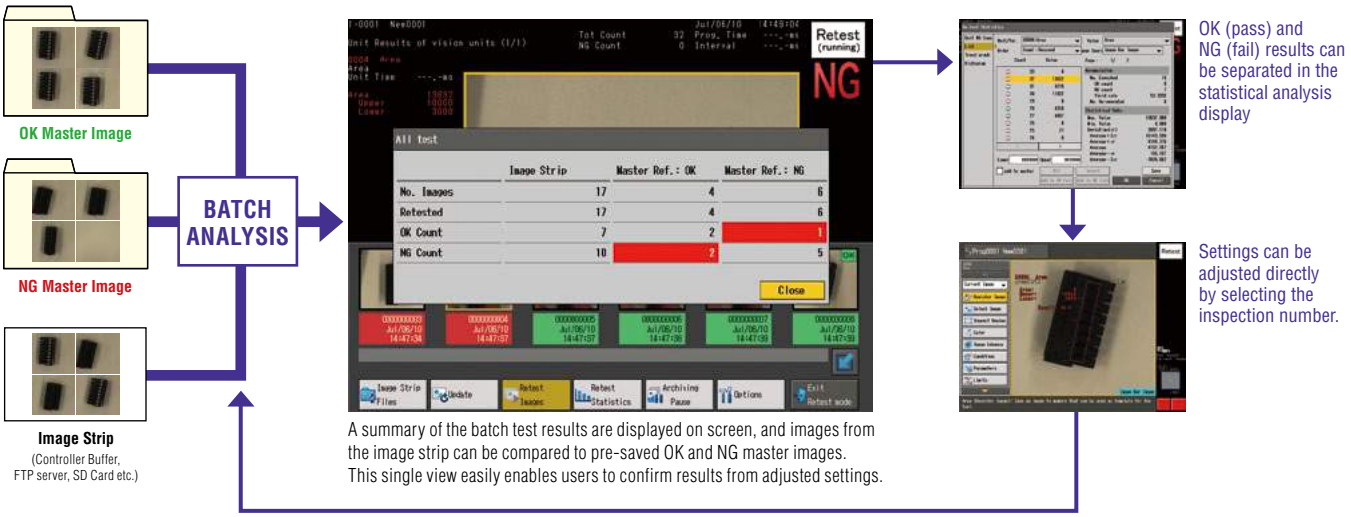
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RUNTIME CHANGES

Powerful run-time process debugging tools

ONLINE OK/NG BATCH ANALYSIS

While the system is processing parts online, the batch results from a series of images (taken from the main memory, an SD card or the FTP server) can be displayed. This allows for the easy confirmation of changes in settings without affecting inspection performance. In addition to the batch testing, Master OK (pass) and NG (fail) images can also be used for comparison purposes. The batch analysis function makes it very easy for a user to fully understand a system's performance at any time without having to collect data or take the system offline.



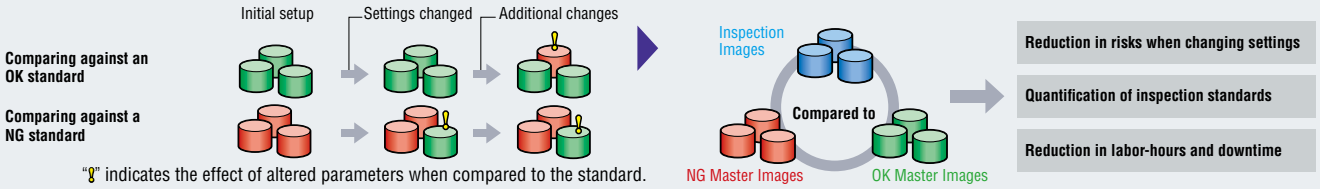
A summary of the batch test results are displayed on screen, and images from the image strip can be compared to pre-saved OK and NG master images. This single view easily enables users to confirm results from adjusted settings.

Conventional performance analysis

When initially dialing in a system or making modifications to existing settings, it becomes very easy to lose sight of the original requirements of the inspection. OK images become NG and vice versa and it becomes harder and harder to meet the desired standard.

Batch Testing

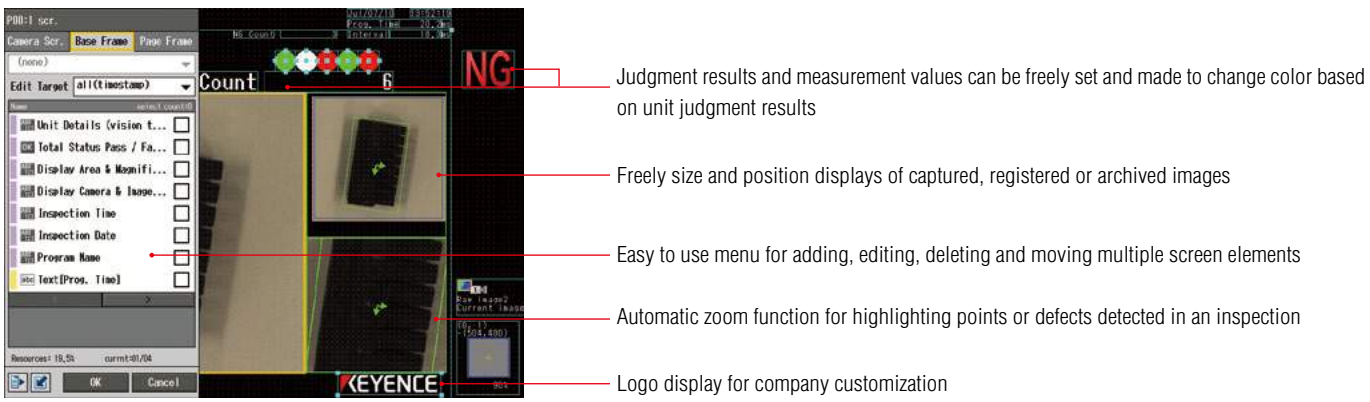
By retesting images against master images, it is easy to confirm whether there are any changes in the inspection standards compared to the initial standard. If changes have occurred having master OK and NG images to work with makes it simple to compare and adjust settings without affecting the original intent of the inspection.



"8" indicates the effect of altered parameters when compared to the standard.

CUSTOMIZED SCREENS & INTERFACES

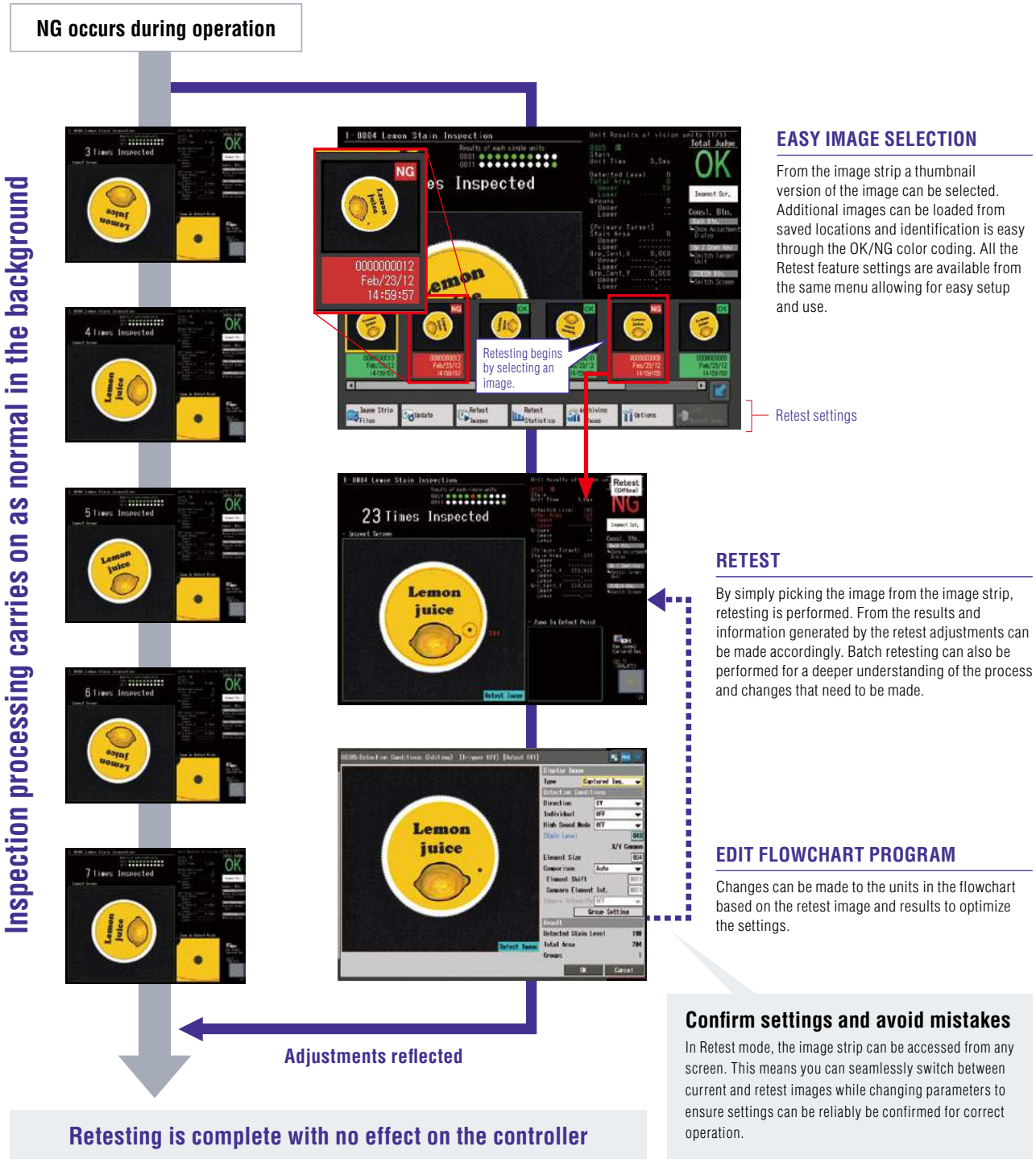
The XG Series supports the creation of custom screens directly on the controller. A fully customized screen can be easily created to display a wide range of results, images or graphics as required. Multiple intuitive screens can be designed for different views of the image processing results



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ONLINE RE-TESTING & FLOWCHART EDITING

The Retest function of the XG Series allows images stored from inspections to be selected, retested, and edits to be made while the controller still fully processes other inspections online. This allows the user to make program adjustments in order to optimize the settings without effecting the current inspection process or causing any downtime on the machine.



EASY IMAGE SELECTION

From the image strip a thumbnail version of the image can be selected. Additional images can be loaded from saved locations and identification is easy through the OK/NG color coding. All the Retest feature settings are available from the same menu allowing for easy setup and use.

RETEST

By simply picking the image from the image strip, retesting is performed. From the results and information generated by the retest adjustments can be made accordingly. Batch retesting can also be performed for a deeper understanding of the process and changes that need to be made.

EDIT FLOWCHART PROGRAM

Changes can be made to the units in the flowchart based on the retest image and results to optimize the settings.

Confirm settings and avoid mistakes

In Retest mode, the image strip can be accessed from any screen. This means you can seamlessly switch between current and retest images while changing parameters to ensure settings can be reliably be confirmed for correct operation.

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USER INTERFACE

Easy creation of customized GUI's
via the drag, drop and click of a mouse

SCREEN EDITOR

Easy creation of the controller display screen and operating interface

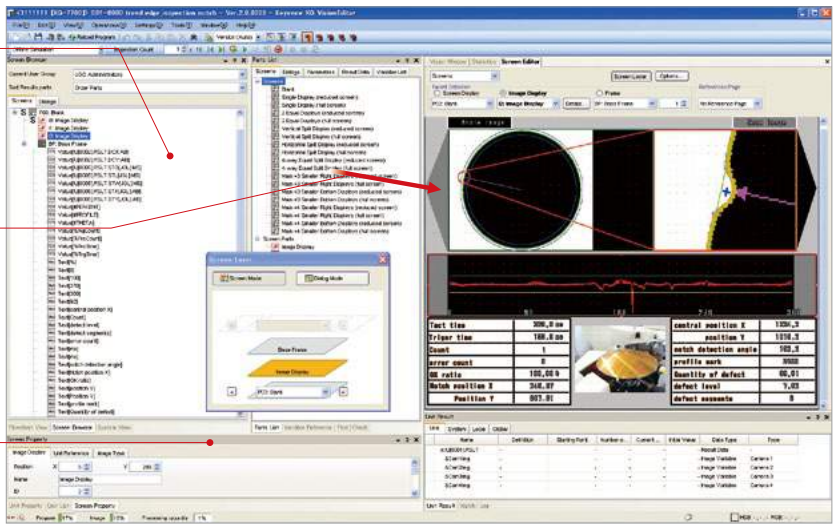
A unique display screen configured to your needs and desires can be easily created by dragging, dropping and re sizing different components from the parts list. By being able to use and configure many components such as BMP images, graphics, text, measurement value and camera images the screen can be designed with the operator in mind. Up to 100 different screens can be created per program for full customization to any process. Screens and components can be easily displayed and switched between, not only via external inputs, but also based on image processing results or settings.

INDUSTRY FIRST

Settings for dialogs or display items can be easily found and navigated to with the tree-view hierarchal screen browser.

Screen positioning is completed by dragging-and-dropping required components, such as camera images and display components, from the parts list.

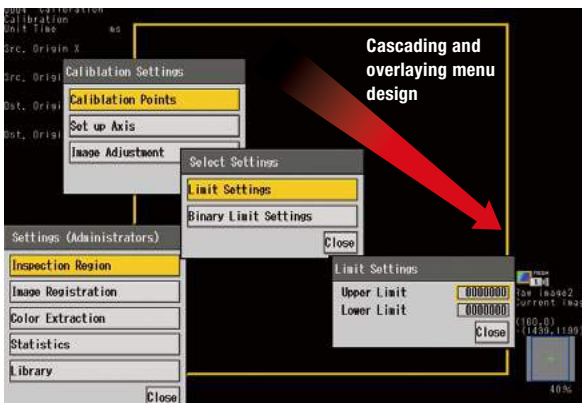
The layered display view helps allow for easy intuitive design of the screen overlays, components and dialogs that would have been typically complex to achieve.



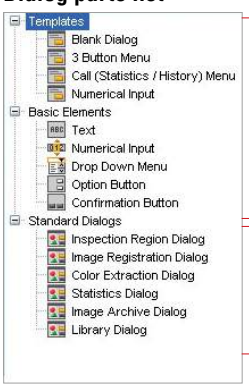
CUSTOM MENU CREATION INDUSTRY FIRST

Create and customize operator menus and interfaces for easy operation

For run-time user interaction with the XG Series, up to 900 unique custom menus can be created per program. Menus can be linked to create cascading walk throughs or choices based on a users input. Menus can also be tied into the timing and operation of the image processing flowchart so that they appear when necessary for a users action and input to be taken. The menus can also be configured and displayed based on the user account logged into the system.



Dialog parts list



Components

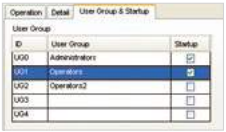
These are the fundamental parts for the creation of a custom menu. Drag and drop from the list the components that suit your needs for your menu.

Built-in menus

Frequently used operations, such as statistics, image archive and library registration. Have already been prepared to be incorporated right away.

User account based menus

By changing the display/non-display parameter for each menu based on user accounts, different menus and levels of operation can be created for administrators and operators.



Detailed dialog display and interaction settings

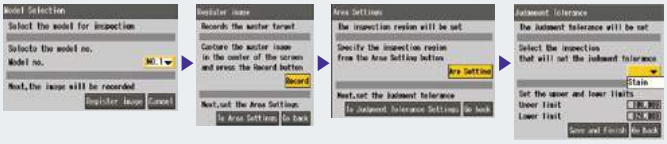
Detailed settings for each menu are possible, including parameters for position, when to display/remove on screen as well as handheld console button interaction.



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Example of custom menu use: Step by step configuration

Step by step procedure changes such as product change over or shift adjustments.



By creating menus for a step by step process (such as calibration) there are no reasons why adjustments shouldn't be made or settings being incomplete and steps missed.

CONVENTIONAL SYSTEMS

Due to different adjustment methods and different personnel making changes, cases often emerge where the setting is incorrect or varies between operators. With conventional systems complex parameter driven menus may need to be understood. It takes time and resources for operators to be trained and sometimes due to the complex menu interface the ability to operate the machine is limited to a few people.

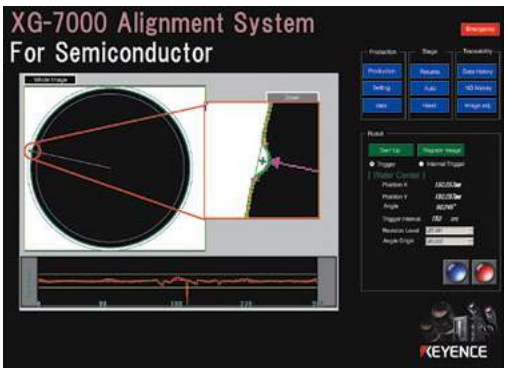
CUSTOM MENUS

Necessary steps and required settings can be put together to match up with the process. Menus can also be attributed to the relevant aspects of the image processing flowchart. This helps make sure that any operator of any level can easily be guided through the process required on the machine.

ActiveX CONTROL

Fully customizable PC interfacing

The XG controller can be incorporated and become an integral part of a machine through the use of the ActiveX control. A PC interface can be designed that not only interacts with the XG Series, but also other aspects of the machine and its operation. In addition to being able to create a PC control interface, measurement data, result information, historical data and file management are also possible through the ActiveX control. Multiple connections can also easily be established and configured for bringing together multiple controllers or machines. All this allows for the collective management of multiple systems into one interface and the development of a full production management system.

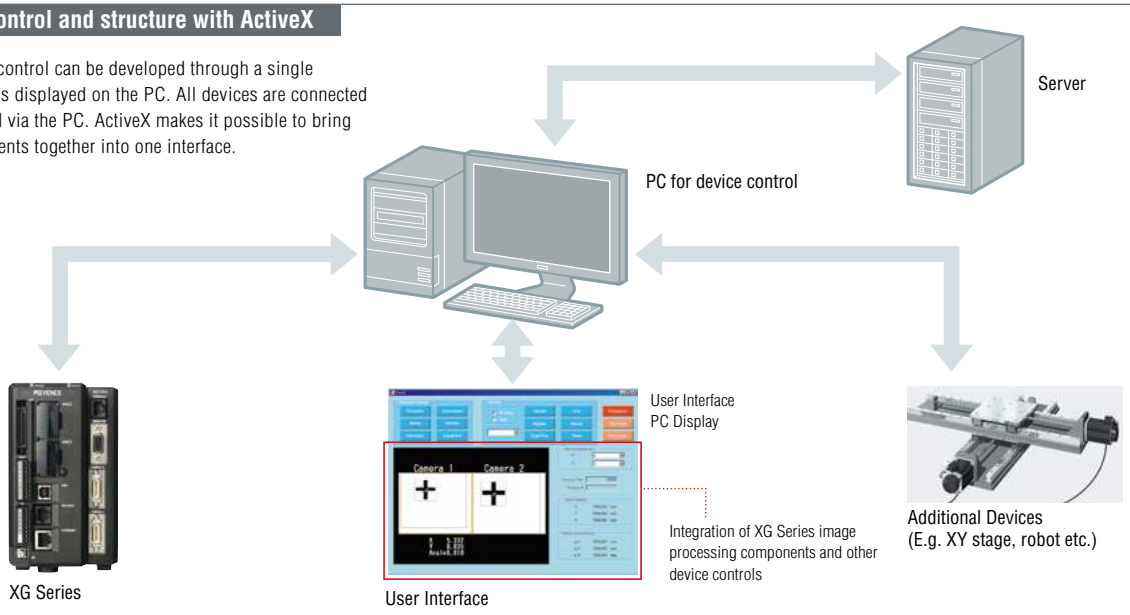


This is an example of a PC interface bringing together camera images and operational buttons for the XG Series vision system as well as other machine functions required for wafer alignment and process control within the semi-conductor industry. The operator only needs to use one interface for both vision and machine control.

• ActiveX is a registered trademark of Microsoft Corporation, U.S.A.

Machine control and structure with ActiveX

Full machine control can be developed through a single interface that is displayed on the PC. All devices are connected and controlled via the PC. ActiveX makes it possible to bring all these elements together into one interface.



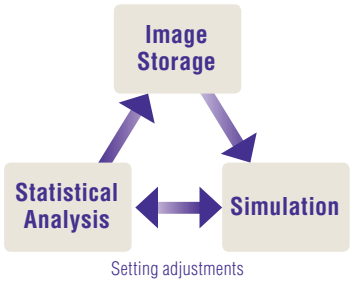
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STORAGE, COLLECTION & SIMULATION

Save only the desired images for analysis and simulation

The image output buffer enables images to be streamed to a variety of external devices (such as an FTP server) making it easy to test and analyze with the simulator software and statistical functions of the XG Series. Being able to define how and what images are stored where significantly helps with the separation, analysis and retesting of failed inspections. Using the simulator and statistical tools together makes the correction and the optimization of settings very easy.

[Setting optimization using the XG Series]



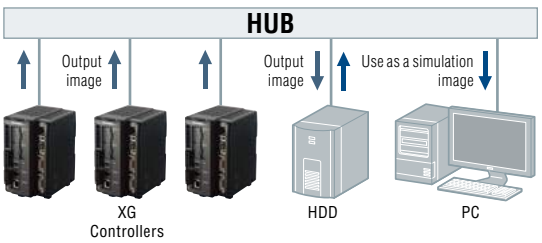
Required items for setting optimization

Image Storage	▮ Save a large volume of images ▮ Specify locations based on conditions
Simulation	▮ Work with the XG Series controller environment for testing on a PC ▮ Re-test and simulate results with stored images
Statistical Analysis	▮ Superior analysis and understanding of processed items ▮ Automatic generation of statistical results including maximum, minimum, yield and standard deviation.

FTP IMAGES DIRECT TO A NETWORK OR HDD DRIVE

Images cannot only be saved directly to the SD card used in the controller, but also transferred directly to NAS* (Network Attached Storage) through a LAN connection. Long-term image storage can also be conducted by connecting an easily sourced large capacity (10Gb, 100Gb, 1Tb etc.) external HDD. In addition, by using the image output buffering option, continuous NG images will not be lost.

* NAS refers to a storage device that is designed for use on networks and contains file server software. Unlike USB based external drives that can be only connected point to point and need to be configured, a NAS device becomes immediately part of the network when it is connected, making it available for all other devices to use. Thus simplifying data browsing and file sharing.



Multiple PC Software simulations can be easily managed and run from the images transferred by FTP. By defining a folder the XG controller can directly output the images to the correct location on the PC for the individual simulator to reference.



PC SIMULATION & REMOTE SUPPORT VIA A PC & MOUSE

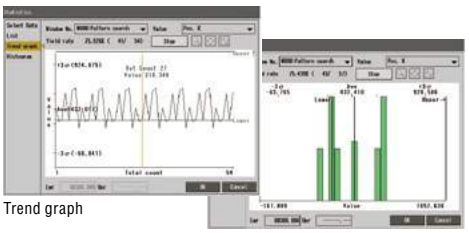
Interact directly with the XG Series GUI via your PC and mouse. Existing settings can be tested and simulated with saved images via the PC simulator. Furthermore, the XG VisionTerminal software offers remote connectivity and data logging capability



Fully interact with the system with a mouse
Process up to 50000 images with Simulator+

STATISTICAL ANALYSIS FUNCTION

Any measurement data or variable value can be displayed as a trend graph or histogram. The result data includes information on yield rates as well as standard statistical data (such as max., min., average, SD and 6σ values).
Up to 100,000 data points can be plotted and saved, allowing for processes to be tracked and optimal settings to be set and recorded.



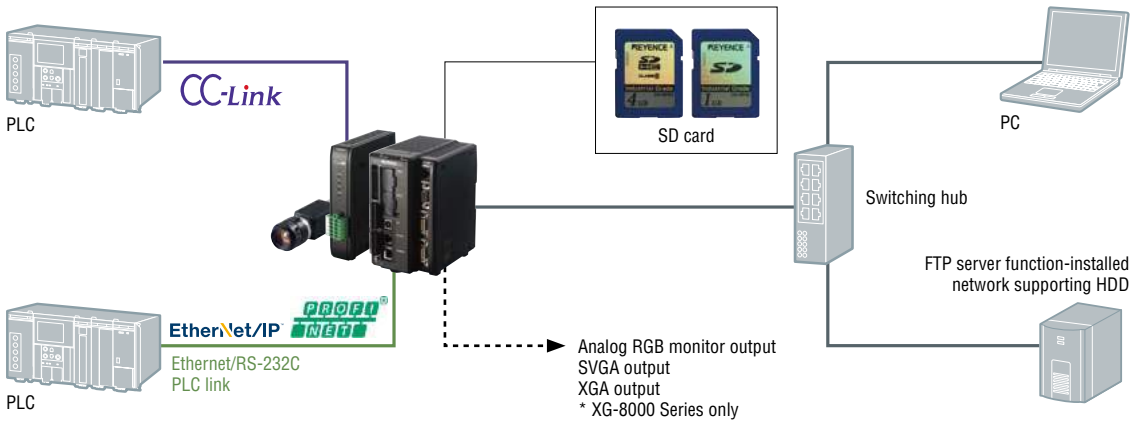
Trend graph
Histogram

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COMMUNICATION INTERFACE

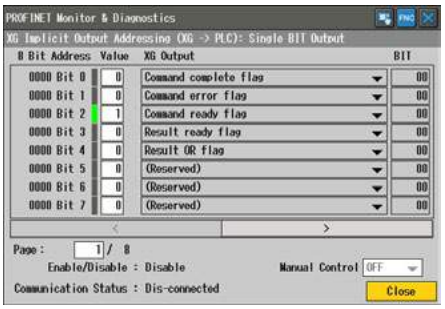
A diverse selection of integration options and utilities for use in any facility

The XG Series supports a wide range of interfaces, protocols and I/O devices. Ranging from CC-Link, PLC-Link, EtherNet/IP™, PROFINET, USB, RS-232C, discrete I/O and SD cards. All these combined give the XG Series the ultimate flexibility for easy integration. Coupled with easy to use monitoring tools, integration man hours and costs can be easily reduced.

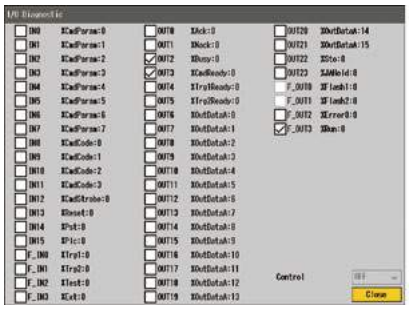


COMMUNICATION MONITORING TOOLS

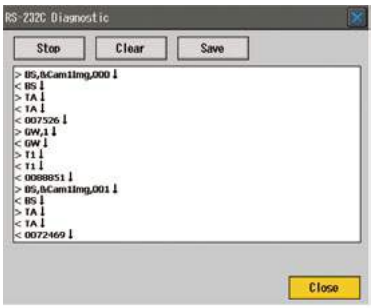
An I/O monitor, RS-232C monitor, EtherNet/IP™ memory monitor, PROFINET memory monitor, PLC-link memory monitor, CC-Link memory monitor, and Ethernet monitor have been loaded on to the XG controller and are extremely beneficial in the verification of communication and I/O terminal wiring, ensuring smooth verification during the startup process.



EtherNet/IP™ memory monitor, PROFINET memory monitor



I/O monitor



RS-232C monitor

EtherNet/IP™ SUPPORT

EtherNet/IP™

To enable easy integration into many existing facilities across many industries the XG Series fully supports EtherNet/IP™ communication. Connectivity can be established with any PLC supporting EtherNet/IP™ via a standard LAN network.

PROFINET COMPATIBLE

PROFINET is an open industrial Ethernet standard that has been equipped with high flexibility and high speed for automation control in a variety of industries and it has been included as part of the communication functions for the XG-8000/7000 Series. If a compatible device is present, it is possible to communicate via the LAN port on the main unit regardless of vendor.

SUPPORTS VNC

VIRTUAL NETWORK COMPUTING

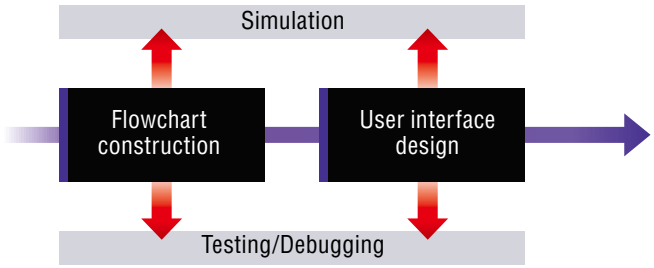
The XG controller has been equipped with a VNC server function. If a PC that has had VNC client software installed on it is available, then it is possible to perform monitor screen display and remote operation via network. Also, monitor screen display is possible even with a verified industrial touch panel that supports VNC client functions.

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Intuitive operation and visual design
for everyone to understand

Easily achieve what you want, without the stress

Integrated image processing development software: XG VisionEditor



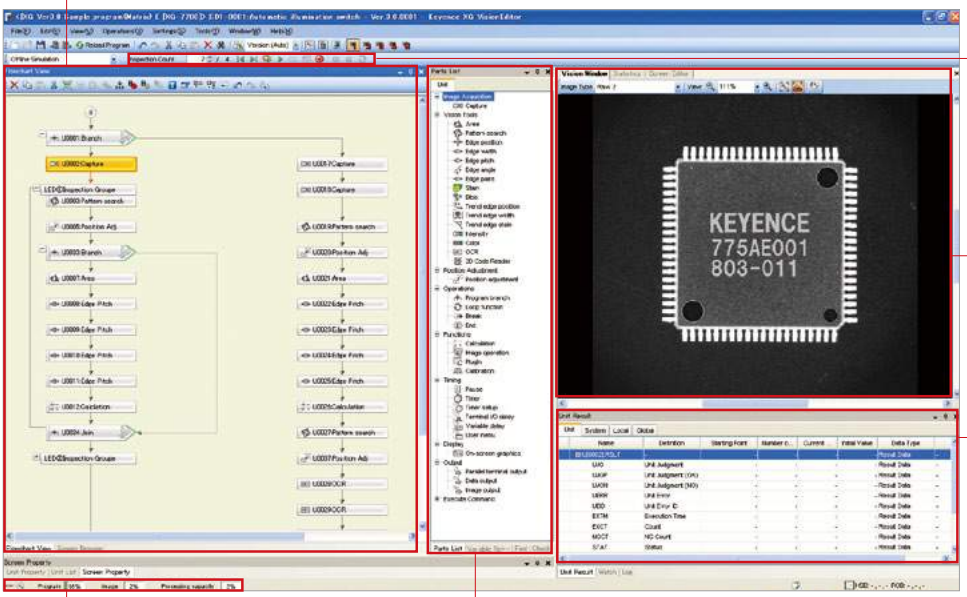
During application testing and solving, simulations and debugging can be quickly conducted at any time, allowing for efficient design.

SEAMLESS DEVELOPMENT, ENABLING FAST POWERFUL YET EFFICIENT APPLICATION SOLUTIONS

The XG VisionEditor is specialized PC software that can conduct everything from the construction of image processing solutions and the creation of user interfaces to debugging and simulations all at once. The PC software does not use programming language, and instead all operations are conducted in an easy to understand GUI environment. Here drag-and-drop dominates, enabling complex processing to be easily developed in minimal time.
Due to the incorporation of debugging tools that simultaneously discover errors (both static and dynamic) that occur during development, man-hours dedicated to debugging have been dramatically reduced. All in all the overall time between construction and deployment have been substantially reduced.
By focusing on the optimization of the tools required for providing a solution (the core of image processing inspections) KEYENCE has given the opportunity for significant improvements in machine vision development efficiency.

Flowchart view

By dragging-and-dropping processing units from the parts list into this section, you can easily construct an image processing flowchart. Debugging is easy as errors are highlighted and the usage of variables can be easily seen.



Simulation tool bar

Simulations can be run from images taken from a connected controller, held on a PC or across a network. Options for continuous program operation, step by step or a single iteration are possible too.

Vision window

In addition to displaying captured images and setting up GUI, you can confirm in real-time the processing results of filters or inspections tools

Unit results

All aspects of result and measurement data from units and variables can be viewed here. The unit results section is also equipped with a watch view allowing the display of only the variables or measurement values you wish to see. Helping allow for easy confirmation and analysis of results. In the unit results you can also conduct editing of the variables making dialing in and changes very easy.

Resource display

Shows the resources used in different areas of the controller from the settings made.

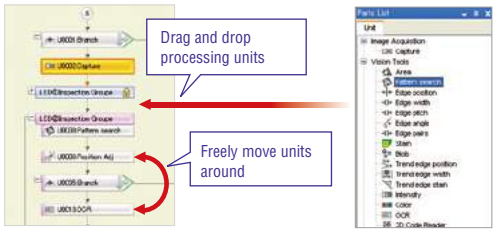
Parts list

Lists everything all the way from inspection tools such as edge detection and pattern matching, to control processing such as condition branching timers and loops. By dragging-and-dropping items from this list to the flowchart, the image processing flowchart can be easily constructed.

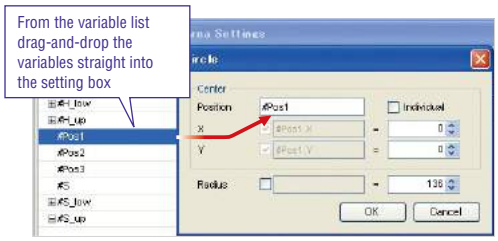
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EASY CONSTRUCTION OF THE IMAGE PROCESSING FLOWCHART THROUGH THE CLICK OF A MOUSE

The basic structure is created through the intuitive Windows based drag-and-drop method. The desired items are simply dragged from the list on the right onto the flowchart to create the structure.
The processing units themselves can also be picked up and moved around the flowchart as desired.

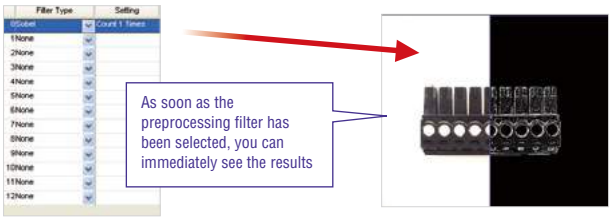


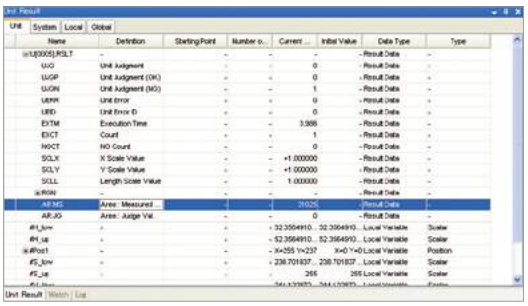
You can even drag-and-drop a variable from the list straight into the unit parameter. Typing is also an option, and input is made easy through the auto-complete functionality. Possible options are shown as the string is built up helping to ensure the right information is entered without errors.



EASILY UNDERSTAND THE EFFECTS OF CHANGES

The XG Series allows you to confirm current/initial settings against any changes ranging from image preprocessing combinations, variable values, through to measurement result differences from parameter changes. By being able to confirm the effect of changes and easily test options quickly, optimal settings can be reached in minimal time.





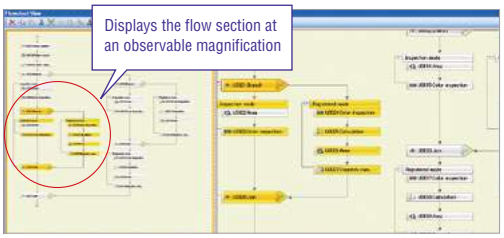
Each variable result according to setting changes can also be understood in real-time via the unit result list.

STRESS FREE LARGE SCALE EDITING

INDUSTRY FIRST

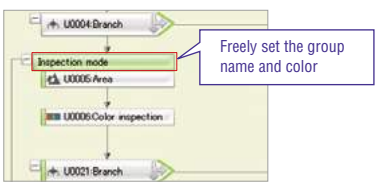
Divided & magnified displays

The flowchart display can be divided and each divide can be magnified as desired. Enabling overviews and specific areas to be viewed at the same time for easy navigation.



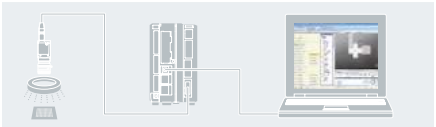
Grouping function

The grouping function allows for efficient flowchart creation and management. Multiple units can be grouped, named, color coordinated and minimized when not required. By managing the units by gathering them into meaningful groupings, even the processing of large-scale flows becomes easier to understand. This function also allows you to copy each individual group and paste these groups into a separate flowchart just like sub-routines.



ON-LINE REAL TIME IMAGE EDITING

The XG VisionEditor software can communicate directly in real-time with any connected controller and camera. Parameter adjustment, simulations and images are automatically transferred, enabling quick program construction and testing.



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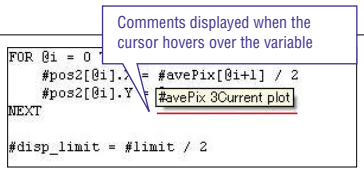
High-end power and flexibility
equivalent to PC based systems

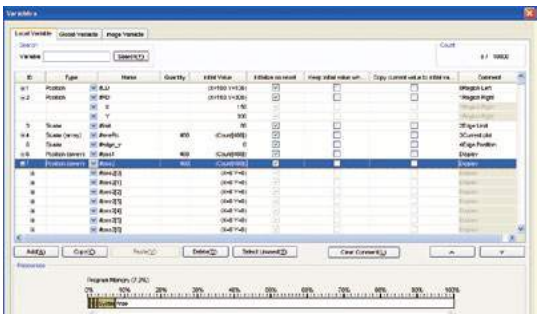
VARIABLE PROCESSING

A wide range of variables are able to be defined, including image, positional, linear, scalar and array based. Variables are not limited to a single program and can be set for local, system or global use. The re-writing and initialization of each variable can be individually set depending on its intended operation. By using the variable setting utilities, even such tasks as the batch substitution of an allocated variable name or searching for a specific variable is made easy.

Variable comment function

Each variable can be assigned comments indispensable to debugging and program review. So as the flowchart becomes large and complicated, variable selection becomes simple.





Variable setting screen

CONTROL PROCESSING

The XG Series provides control processing including conditional branching and looping essential to program flexibility and customization. This allows for flexible image processing enabling switching and processing based on changing conditions. Timing controls such as processing delays or waiting on terminal/operator interaction are also available. As the vision flowchart can be created to interact with different machine and control processes so the XG Series can easily become an embedded part of the overall machine and system.

Control processing definitions

Branch - Join	Based on input value branch flowchart accordingly (up to 64 points)
Loop	Repeat unit operation until end or break condition
Loop End	Stop loop
Break	Break loop and exit

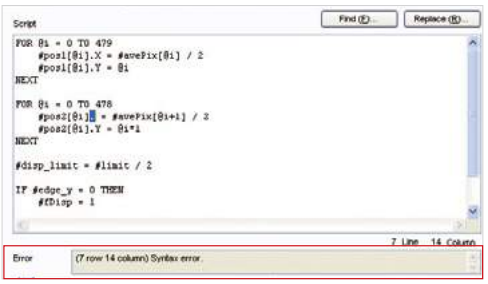
Timing control definitions

Pause	Pause for a specified time
Timer	User specified timer
Timer setup	Pause until specified user time finishes
Terminal I/O Delay	Pause until changes in specified I/O occur
Variable Delay	Pause according to the results from selected variable compared with a selected reference value
Wait dialog	Pause until changes made by an operator

FLEXIBLE CALCULATION & SCRIPT BASED PROCESSING

Calculations are also essential in customization and the XG Series allows for over 100 different functions and commands to be used. Calculations and script can be quickly created by dragging and dropping in functions from the parts list. Direct typing, cut, copy and paste are also supported, along with an auto-complete function to help minimize input errors. Script based design is also possible making complex calculations easy to break out and understand.

Up to 5000 characters per single calculation



Automatic call out error checking function

AUTOMATIC & INTERACTIVE COMMAND PROCESSING

Commands like program switching, image capture, reset, start/stop operation log, and so on, typically require external control. However such commands can now be automated and made an integral part of the image processing flowchart. The command set is of such a power that the controller can be made to control itself. Machine functionality at higher levels than the image processing alone is also possible with the in-built commands. For instance changing to a different displayed image, zooming in on a defect based on an inspection result or saving image data for a certain part failure are all possible, as are many things due to the wide range of commands available. KEYENCE has also provided the ability to create custom commands which allow the user to combine specified built-in commands into a single command making macro based simple operation possible.

Examples of built-in commands

System control (73 types)	Common commands include: program switching, image save, trigger input enable/disable, mode switching (run/stop), reset, write variables, clear history data, export history data, image capture, start/stop operation log
User interaction (22 types)	Common commands include: open/close dialog boxes, image switching, image zoom, image scroll, change password, switch user accounts

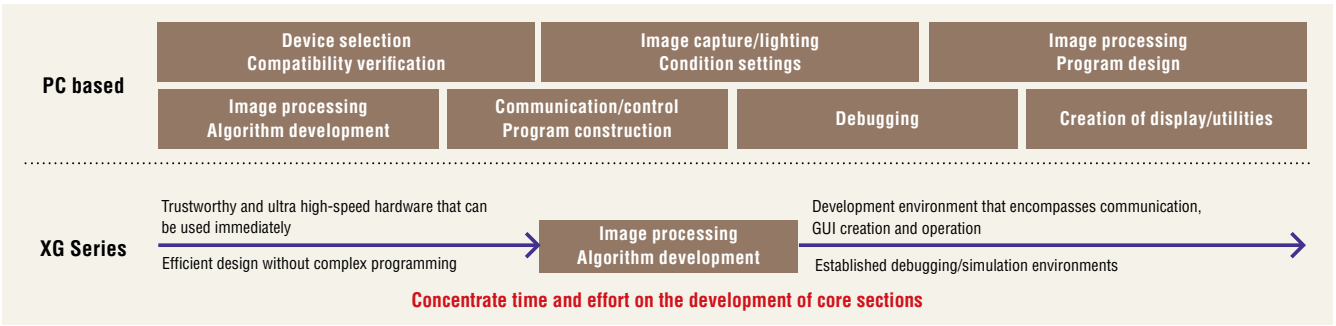


Command list

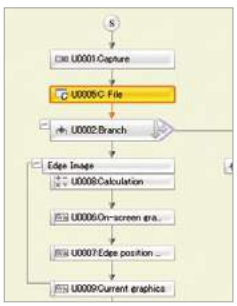
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THE USER-DEFINED C-LANGUAGE UNIT CAN BE FREELY INTEGRATED INTO THE PROCESSING FLOW

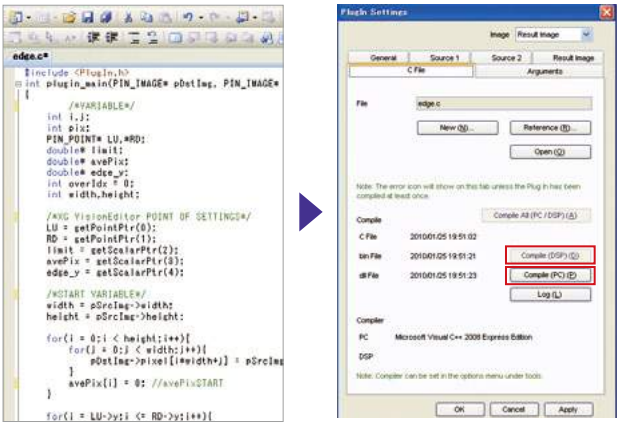
Source code constructed by the user in C can be integrated into the XG process flow. The essential sections of image processing, communication output settings and the creation of displays are developed efficiently and without complex programming, allowing for concentration of resources toward the development of core processing sections. The source code can be compiled with a single click, and can be debugged during simulation by coordinating with the C-language development environment.



Examples of C-language Unit uses				
	Pixel-unit access to the image data	• Unique filter development • Unique algorithm development • Appropriation of company assets	Calculations, scripting and variable processing	• Condense large calculations into one unit of operation • Process large more complex calculations • Increase the processing speed of large computational calculations



Insert the C Plug In Unit into the flow in order to reflect the independent algorithm



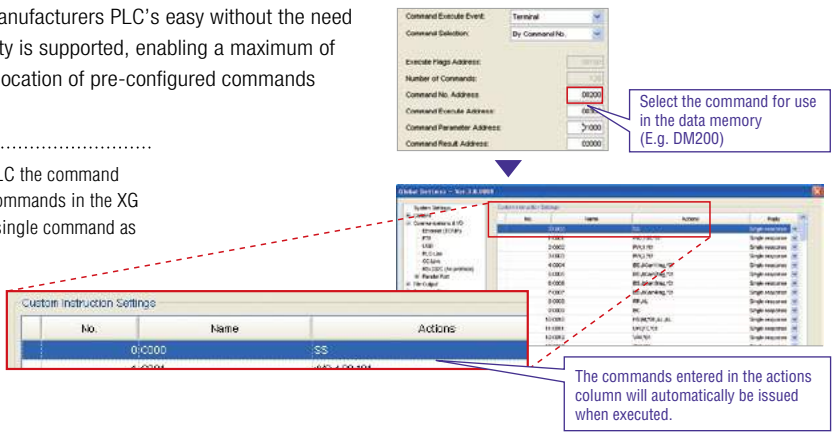
Compile the source code constructed using C-language with the touch of a single button

The compilers for the PC and XG controller environments maximize the ease of use by using DSP native commands rather than scripts or an intermediary language.

SIMPLE, YET SOPHISTICATED EXTERNAL CONTROL VIA PLC LINK OPTION & CUSTOM COMMAND CONFIGURATION

The PLC link option helps make connectivity to different manufacturers PLC's easy without the need for complex wiring. Both RS-232C and Ethernet connectivity is supported, enabling a maximum of 128 custom commands to be easily configured with the allocation of pre-configured commands directly to data memories.

By allocating the XG Series command to a specific address of the PLC the command can be easily executed by the PLC. By being able to make custom commands in the XG program, the PLC operation is further simplified by the calling of a single command as opposed to processing many in sequence.



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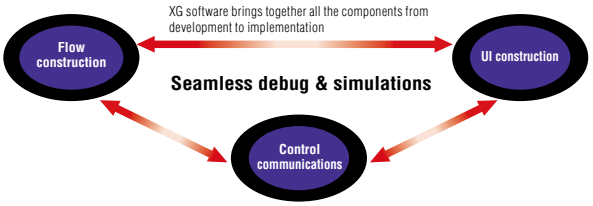
DEBUGGING

Automatic error checking and easy debugging - the secret to development efficiency

SEAMLESS SIMULATION & DEBUGGING

Highly efficient program development

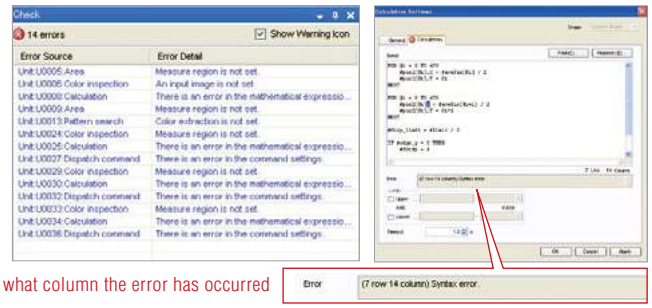
The XG suite of software gives the opportunity for simulations, whether it be for image processing flow, GUI construction or I/O and control to be run at any point during development. Having this capability at anytime means debugging can be performed whenever desired helping maintain development efficiency all the way to deployment.



ERROR CHECKING FUNCTION INDUSTRY FIRST

Instantly see and go to the source of an error

This function enables you to check for the presence of errors within the inspection settings simply by pushing the check button. This automatically creates a list for any errors found and reports back on the error type and their location. In units that have calculations, functions and expressions definitive information is not only displayed on the type of error, but also the row and location of the error.

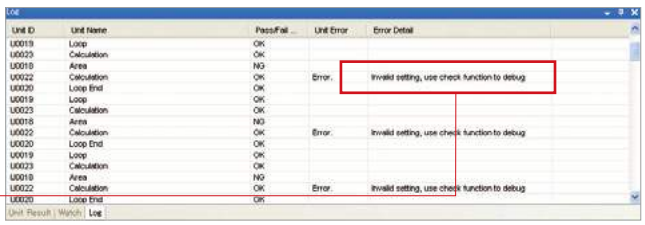


Checks down to exactly and what row, what column the error has occurred

AUTOMATIC LOGGING FUNCTION INDUSTRY FIRST

Trace dynamic errors

Errors that occur under specific conditions are relatively difficult to find. In the XG VisionEditor software, all processing results and errors from simulations, are displayed in a continual log format. Debugging and error checking can be quickly performed as dynamic errors can be easily found, checked and resolved.

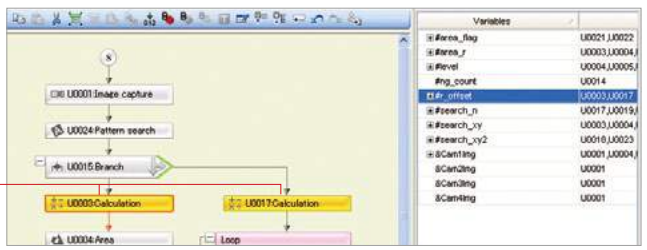


Dynamic errors, such as those that occur when variables occur outside the reference range, are also included in the display.

VARIABLE REFERENCE LIST INDICATOR INDUSTRY FIRST

Quickly see and locate where variables are used

The XG VisionEditor software also incorporates a variable reference list that allows the quick verification of exactly which variables are being used, and where. In addition to the unit ID being show next to the variable, the unit can be made to flash in the flow view by simply clicking on the variable. This makes it very easy to see all the locations where a variable is referenced and used.



By selecting a variable, all reference destination units on the flow view will flash.

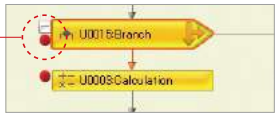
Variable list

FLOWCHART BREAK FUNCTION INDUSTRY FIRST

Step by step debugging

Multiple break points (pauses) can be used anywhere on the flowchart. These cause the running program to pause during simulation. When a break point is reached all processes, including variables can be checked for efficient debugging. This debugging function can also be enhanced by using multiple break points so a step by step running process can be setup.

Each unit can be independently processed and stepped through. By pushing the re-open button when a breakpoint is reached the image processing flow will continue to run until the next break point is reached. By using the step button only the current unit will be processed.

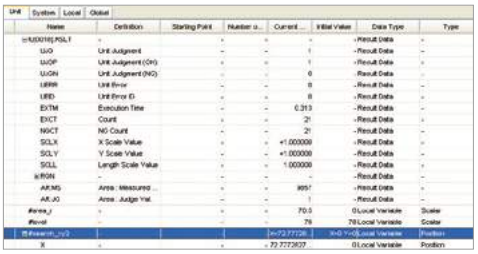


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UNIT RESULT & VARIABLE INFORMATION LIST

Quickly understand unit and variable operation

All units used in the flowchart and associated variables can be viewed and confirmed in a tree based list view. This is beneficial for seeing and confirming all the results and data that is being processed. Sorting and filtering is also possible so only the desired unit result data and variables are shown. To allow for easy setting, click on any unit or variable. The properties open and parameters can be changed directly then and there.



FULL PC SIMULATOR FUNCTION

Supporting up to 50,000 images

The inspection settings developed in the XG VisionEditor can be automatically run directly in the XG Vision Simulator from the VisionEditor software.
Up to 50,000 images can be used and processed to mimic on a PC the exact operation of the XG controller. The simulator displays the configured GUI along with dialogs and supports output data (CSV format) while allowing for simulated I/O control and external input.



Measurement results, variables and I/O can be all shown at the same time.

GUI used during operation displayed complete with dialog menus.

STATISTICAL ANALYSIS FUNCTION

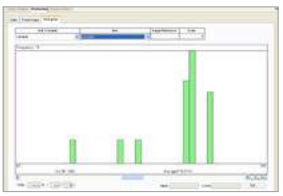
Obtain optimal settings in minimal time

Any measurement data or variable value can be displayed as a trend graph or histogram. In the trend graphs, up to 4 graphs of any value type can be simultaneously displayed. Optimal settings can be easily configured by lining up different graphs for multiple results based on changes in the processing conditions. The result data includes information on yield rates as well as standard statistical data (such as max., min., average, SD and 6σ values).



Up to 4 trend lines displayed simultaneously

Trend graph



Histogram

TRACE LOG FUNCTION INDUSTRY FIRST

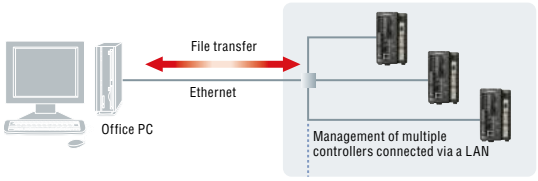
Easily troubleshoot I/O and signal processing

The trace log function is a great tool to help with processing and I/O troubleshooting. Giving integrators and developers the capability for checking and monitoring the sequencing of units being processed, I/O signals and commands. The results display can be split and the processing time for each unit along with other information can be easily displayed. The trace log can also be saved and be used at a later date as a reference guide.



REMOTE DATA LOGGING & MONITORING SOFTWARE: XG VisionTerminal

The XG VisionTerminal software enables the remote monitoring, logging and support of any XG Series controller connected to a PC via a standard network. Maintenance man-hours, down-time and business trips can be significantly reduced as problems can be resolved remotely with the transfer of setting files and image data.



Main functions

- **Remote desktop function** … Enables the verification and remote operation of a connected controller, without extra data being sent and interfering with controller processing.
- **Logging function** ..... Enables the display, logging of measurement results and storage of image data to a PC folder from an inspection with any connected controller. This function also supports the accumulation output buffer of the controller to ensure complete data collection.
- **File acquisition function** … Enables the transferring of setting data files and image data files between the XG Series controller and a PC.

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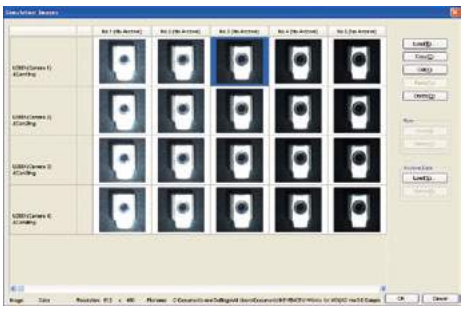
UTILITIES AND SECURITY

Additional utilities and security based functions for full system development

USEFUL UTILITIES FOR DESIGNERS

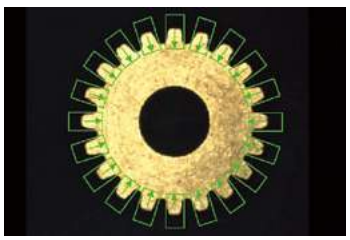
PC Image Settings

With a thumbnail filmstrip view, captured images can be easily managed inside the XG VisionEditor software. The collection of live images from a connected controller or the image archive with historical measurement data can be done with the couple of clicks of the mouse.



Multiple region distribution and alignment

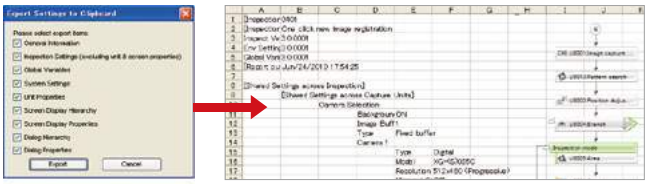
Setting up multiple inspection regions that need to be equal distance from each other can be a mundane, time consuming task. The multiple region distribution function allows for quick distribution of multiple unit inspection regions in a circle, arc or straight line.



An example of using multiple edge position regions equidistant from each other to check teeth and overall circumference of a cog.

Windows Clipboard output for setting details and flowchart

Detailed settings and the image processing flowchart can be copied into the Windows Clipboard with a single click. Having parameters formatted to be used with Excel means information can be easily saved for later reference or the creation of a settings manual and other documentation.

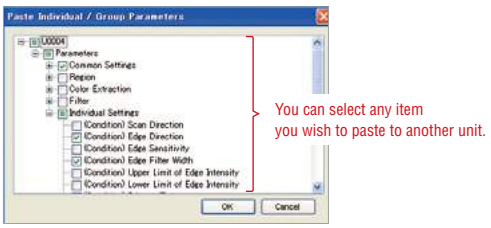


Clipboard output items

· Excel is a registered trademark of Microsoft Corporation, U.S.A.

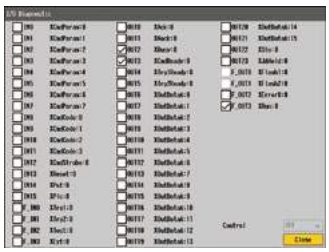
Repeat, partial copy and paste

Normal copy and paste functionality is enhanced with the repeat and partial paste option. Repeat paste allows for multiple units to be constructed all at once with one operation, saving countless repetitive operations. Partial paste allows for user selected parameters to be pasted across multiple units, which becomes very useful when one modified setting needs to be applied to many units.

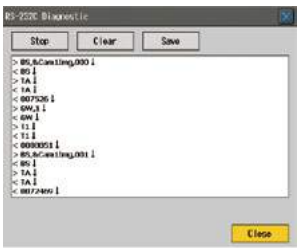


I/O MONITOR FOR SMOOTH INTEGRATION

The I/O and RS-232C monitor function can be displayed on screen via the XG Series controller and is extremely beneficial for the verification of RS-232C communication I/O terminal wiring during initial integration.



I/O monitor



RS-232C monitor

CONFIRMATION OF HISTORICAL INSPECTION RESULTS DURING OPERATION

NG images and measurement results saved to the controller can be easily verified on the controller screen without any influence on processing during operation.

SIMPLE MULTI-CONTROLLER SETUP WITH REMOVABLE SD CARD

Multiple and replacement controllers can be easily setup with the external SD card. Settings files can be easily copied across and a controller is ready to go in the matter of minutes.

HANDHELD CONSOLE

On-site changes can be made where a mouse and PC are not permitted with the disconnectable handheld controller.



IMAGE OUTPUT BUFFER (ensuring complete image output)

The external image output function (SD card, PC application, FTP servers etc.) works with the same image bank as used for image capture. As the inspection and output result only occur after the image is saved, the image is always available for output allocation. Even if the output transfer process is backed up due to uncontrollable protocol demands, the image output has its own dedicated buffer. This ensures all images are accounted for and output (within the buffer capacity), even if delayed.

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SECURITY RELATED FUNCTIONS

User account and grouping management

Up to 100 different user accounts with individual passwords can be registered. At the same time there are also 5 user groups that user accounts can be allocated to. For each group different ranges of permissions and access levels can be set including editing, menu operation, and screen displays. Different interfaces, dialogs and button control can also be customized based on the needs of different operators, technicians, QA staff and administrators.

Intellectual property protection

To help with intellectual property protection various passwords and features are available as standard. A password can be set that protects the opening and editing of inspection setting files in XG VisionEditor, so the inspection setting file cannot be opened unless the correct password is used. In addition the unique controller ID can be referenced in the inspection setting file. Preventing the copying and running of inspection files on another controller. This helps maintain ownership for any image processing development while preventing the stealing of intellectual property.

Operation log

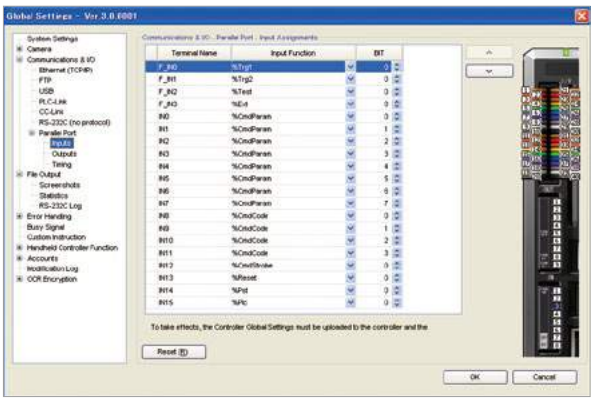
The operation log when used keeps and stores a date & time stamped log of all the button presses and settings changed by a user. This information can then be accessed as a CSV file for machine process security and management.

Controller password lock setting

A password lock can be placed in order to prevent operator errors by ensuring that inspection units (from within the flow constructed in XG VisionEditor) cannot be edited through the controller.

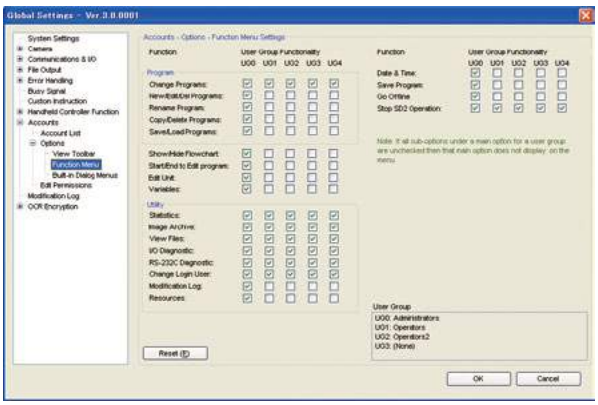
FREE I/O TERMINAL ALLOCATION

The XG Series supports free assignment and allocation of all I/O terminals. This allows for inputs and outputs to be easily distributed based on terminal configuration and switching state (normally open/closed) in accordance with the machine/PLC requirements.



USER GROUP FUNCTION MENU ACCESS

The function menu is the heart of conducting and managing the flowchart and operations directly on the XG Series controller. Operator error can be prevented by enabling the display/or non-display of different options depending on the access needed for the 5 user groups.



CUSTOM MACHINE MANUFACTURING

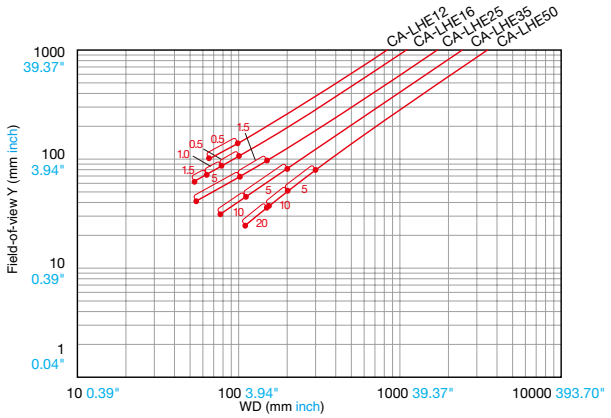
The KEYENCE XG Series allows for OEM customization to enable full incorporation into a custom machine

Customizing the startup screen	Display of BMP data such as a company logo or machine model is possible on the startup display screen.
Camera logos	The KEYENCE logo and model numbers used on the camera body are all stickers and can be removed as required.
Blank handheld console	For on-machine changes with the handheld console a blank version (OP-84236) is available for customization.
3 levels of intellectual property protection	1. "Controller password lock setting" prevents the editing of flowcharts that have been locked in the XG VisionEditor software. 2. "VisionEditor password setting" allows for the protection of inspection setting files used in the PC XG VisionEditor software. 3. "Controller ID matching function" allows for only the matching XG Series controller to run the inspection setting files.

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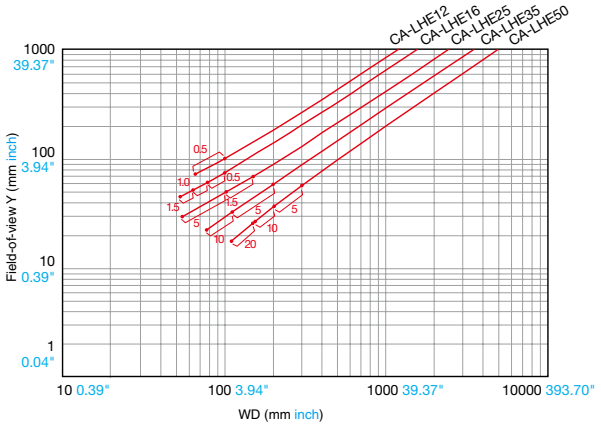
LENS CHARTS

CA-H2100C/M (When the CA-LHE Series is attached)



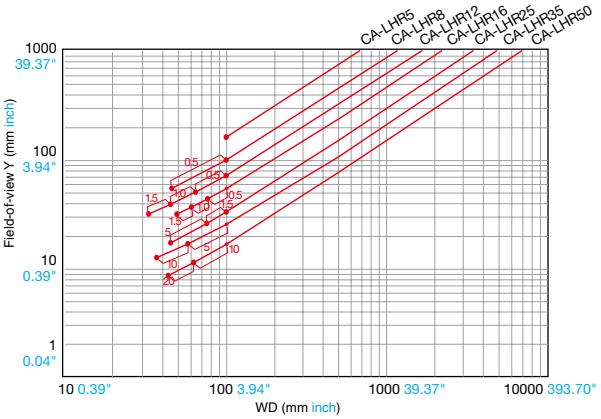
4/3" image sensor size: 5104 × 4092

CA-HX500C/M (When the CA-LHE Series is attached)



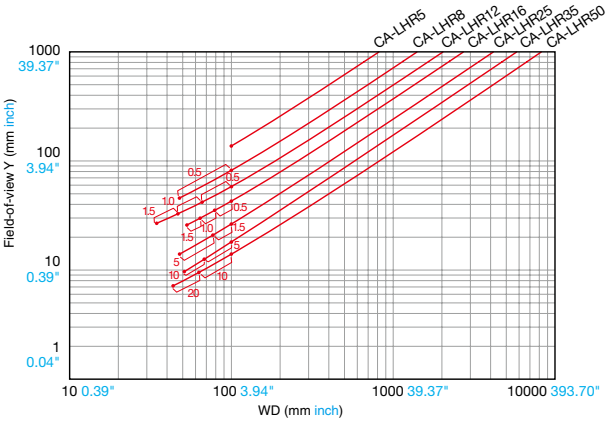
1" image sensor size: 2432 × 2040

XG-H500C/M (When the CA-LHR Series is attached)



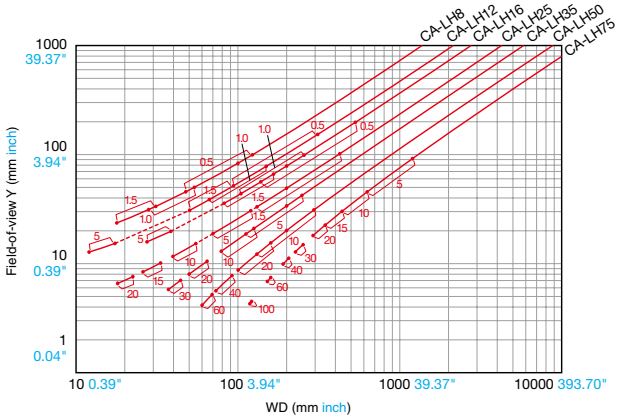
2/3" image sensor size: 2432 × 2050

CA-HX200C/M (When the CA-LHR Series is attached)



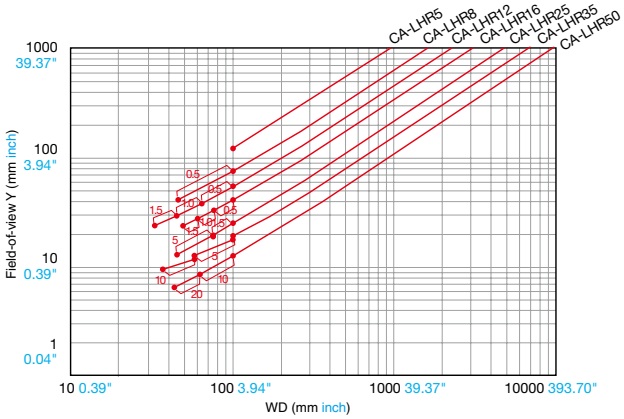
2/3" image sensor size: 1600 × 1200

CA-HX200C/M (When the CA-LH/LHxG Series is attached)



2/3" image sensor size: 1600 × 1200

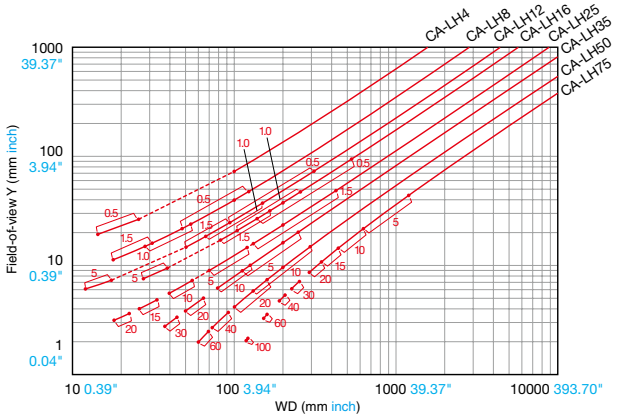
XG-200C/M·XG-H200C/M (When the CA-LHR Series is attached)



1/1.8" image sensor size: 1600 × 1200

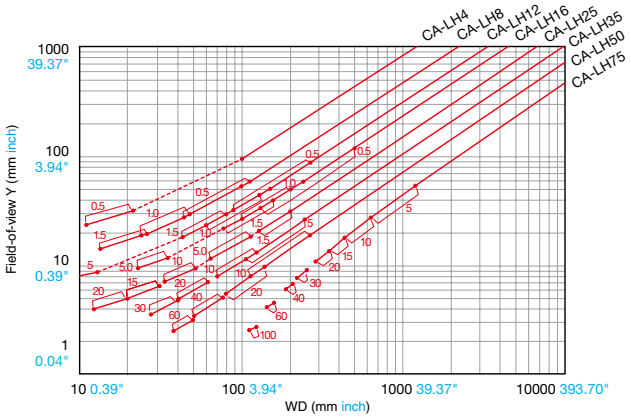
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CA-HX048C/M (When the CA-LH/LHxG Series is attached)



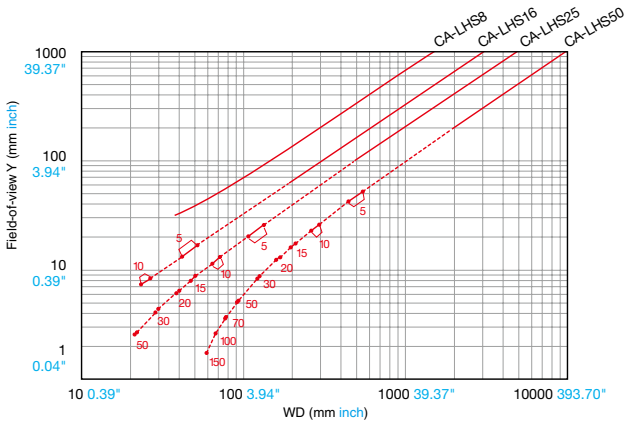
1/3" image sensor size: 784 × 596

XG-035C/M·XG-H035C/M (When the CA-LH/LHxG Series is attached)



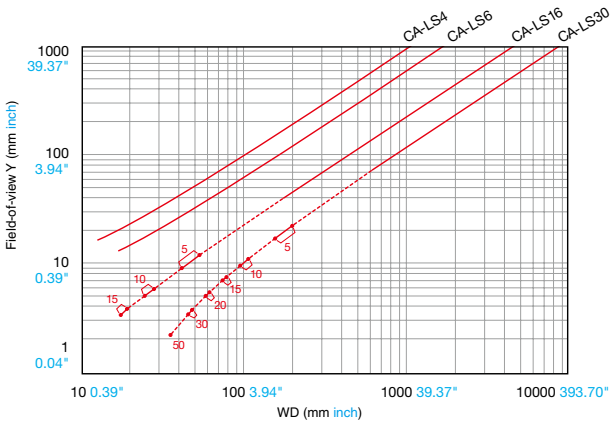
1/3" image sensor size: 640 × 480

XG-S200C/M (When the CA-LHS Series is attached)



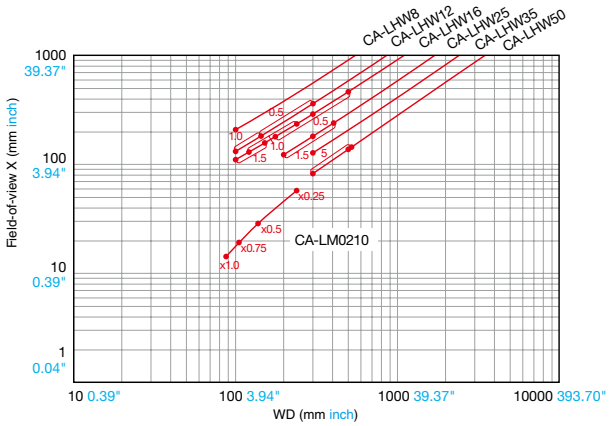
1/1.8" image sensor size: 1600 × 1200

XG-S035C/M (When the CA-LS Series is attached)



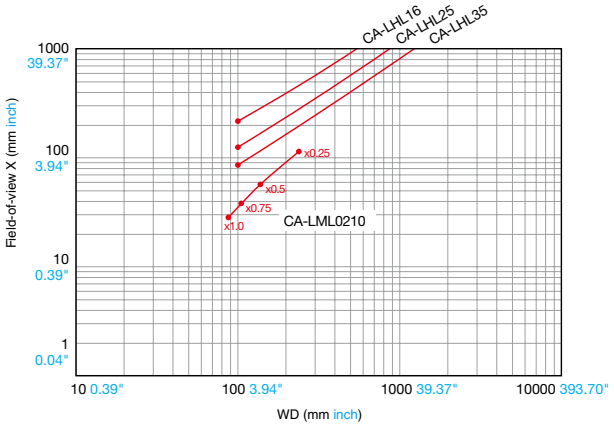
1/3" image sensor size: 640 × 480

XG-HL02M/XG-HL04M (When the CA-LHW Series is attached)



1" sensor size: 2048 pixels/4096 pixels

XG-HL08M (When the CA-LHL Series is attached)



2" sensor size: 8192 pixels

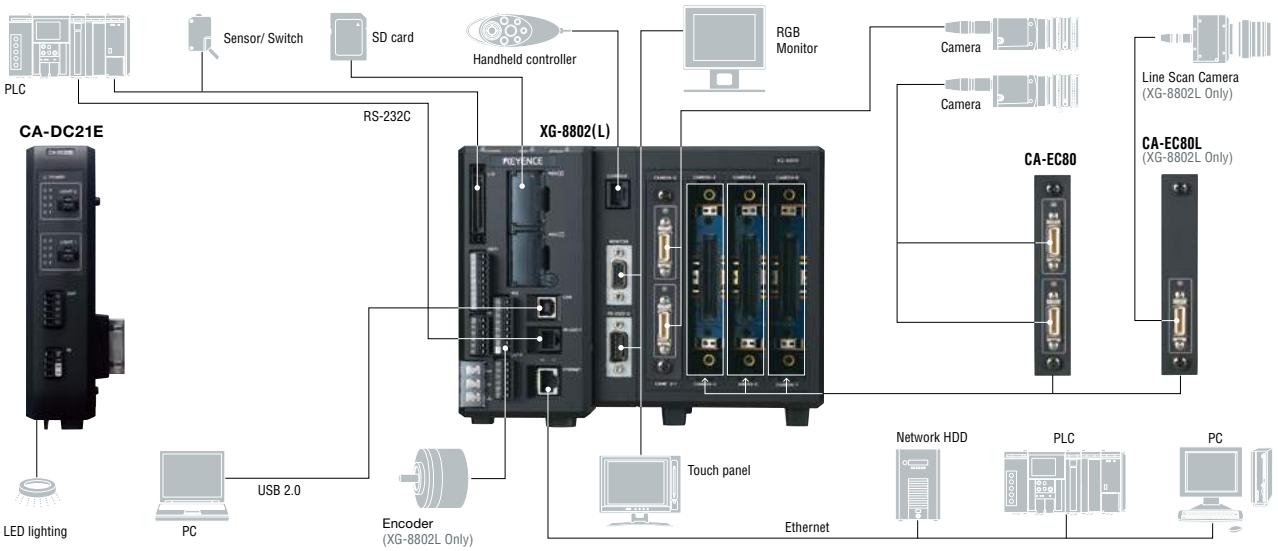
* Using close up rings may result in distortion and lower resolution around the edges of the image area/CCD.
For the other field-of-view graphs, refer to the user's manual.

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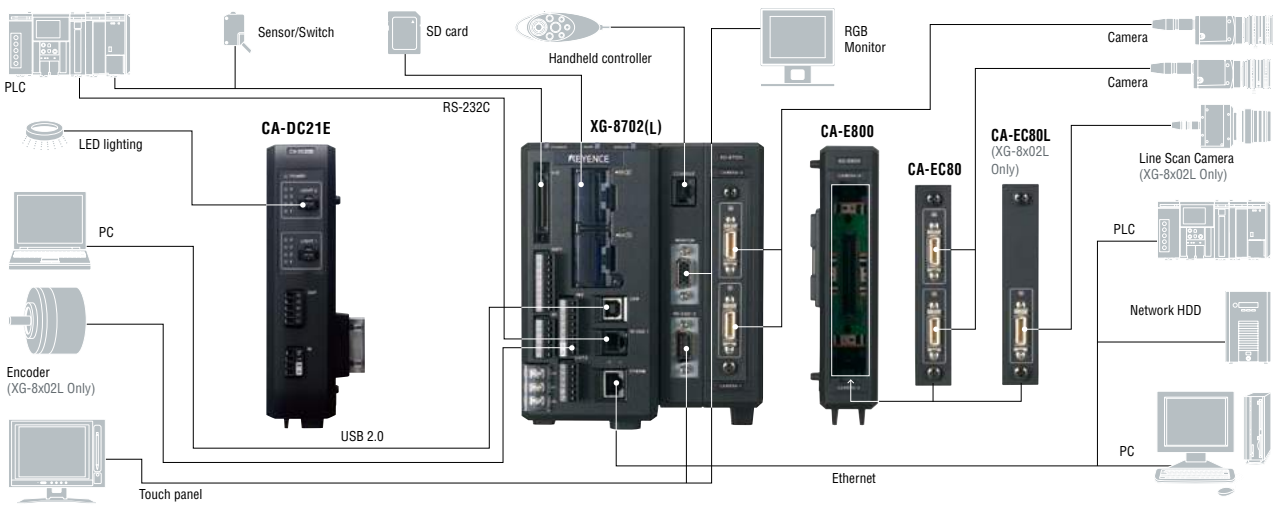
SYSTEM CONFIGURATION

XG system configuration diagram

SYSTEM CONFIGURATION XG-8802(L)

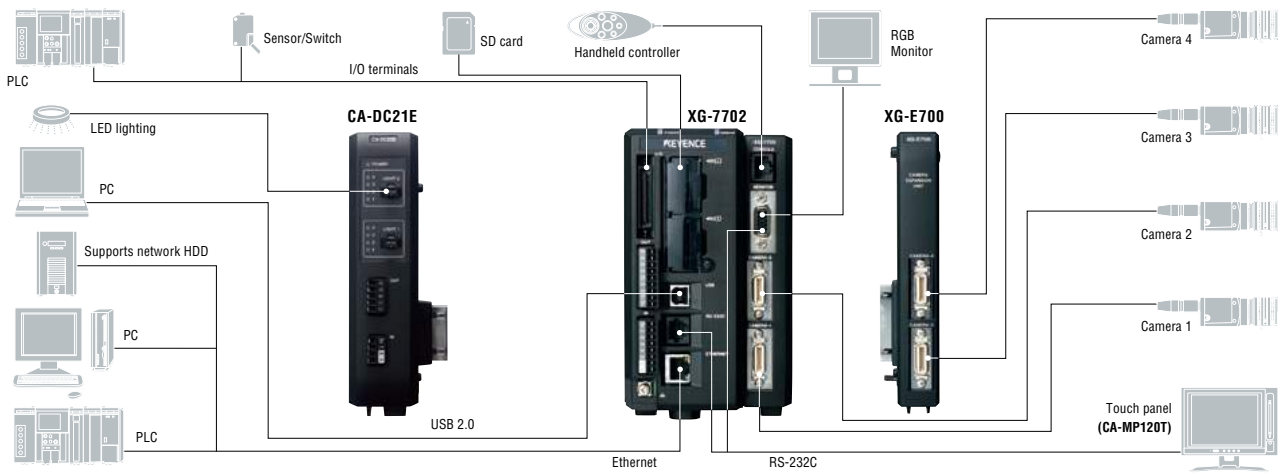


SYSTEM CONFIGURATION XG-8002/8502/8702(L)



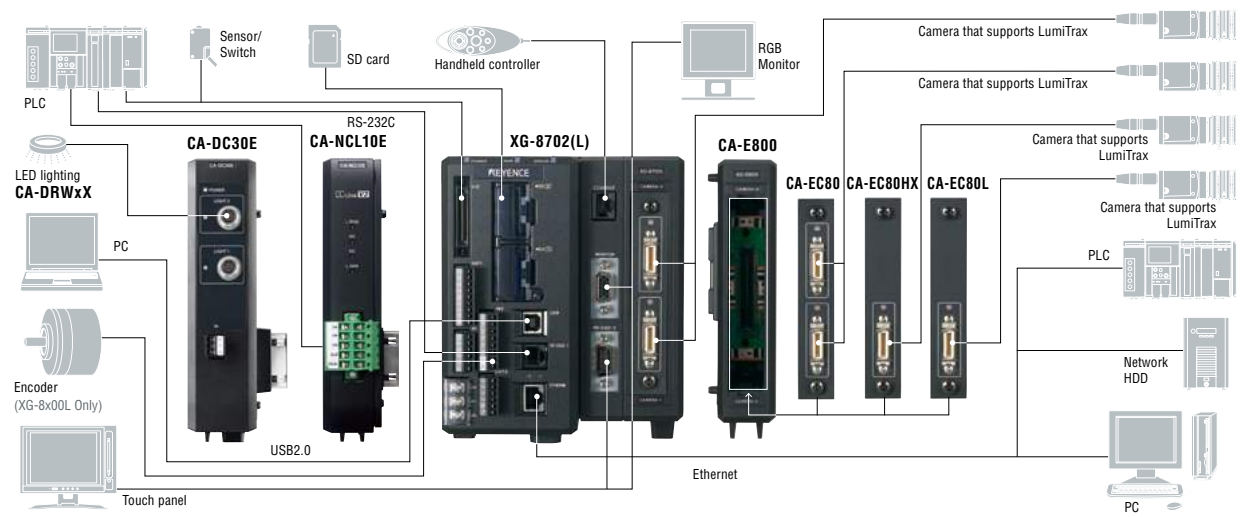
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SYSTEM CONFIGURATION XG-7000 SERIES



XG system configuration diagram (when LumiTrax™ is used)

SYSTEM CONFIGURATION XG-8002/8502/8702(L)



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PRODUCT LINEUP

Controllers



High-speed, high-capacity controller
(supports all area cameras up to 5 megapixel)
XG-7702(P)

High-speed controller
(supports all area cameras up to 2 megapixel)
XG-7502(P)

Standard controller
(supports all area cameras up to 470K)
XG-7002(P)



High-speed, high-capacity controller
(supports all area cameras up to 5 megapixel)
XG-8702(P)

High-speed controller
(supports all area cameras up to 2 megapixel)
XG-8502(P)

Standard controller
(supports all area cameras up to 470K)
XG-8002(P)



High-speed, high-capacity
line scan controller
(supports all line scan cameras up to 8K and area cameras up to 5 megapixel)
XG-8702L

High-speed, line scan controller
(supports 2K line scan cameras and area cameras up to 2 megapixel)
XG-8502L



Multi-camera, high-speed,
high-capacity controller
(supports all area cameras)
XG-8802(P)
includes 1 area camera unit



Multi-camera, high-speed,
high-capacity controller
(supports 2K line scan cameras and all area cameras)
XG-8802L(P)
includes 1 line scan camera unit

Expansion unit



Camera expansion module
XG-E700
XG-7000 Series only



Camera expansion
module
CA-E800

XG-8000 Series only

Area camera unit
CA-EC80



Line scan camera unit
CA-EC80L



CA-HX Series input unit
CA-EC80HX





LED light control
expansion module
CA-DC21E



LumiTrax™
supporting, light
control expansion
module
CA-DC30E

Area Camera



16x high-speed,
21 megapixel camera
CA-H2100C (Color)
CA-H2100M (Monochrome)



16x high-speed,
5 megapixel camera
CA-HX500C (Color)
CA-HX500M (Monochrome)

16x high-speed,
2 megapixel camera
CA-HX200C (Color)
CA-HX200M (Monochrome)



16x high-speed,
470,000 pixel camera
CA-HX048C (Color)
CA-HX048M (Monochrome)



11x high-speed, 5 megapixel camera
XG-H500C (Color)
XG-H500M (Monochrome)

7x high-speed, 2 megapixel camera
XG-H200C (Color)
XG-H200M (Monochrome)

7x high-speed, 310,000 pixel camera
XG-H035C (Color)
XG-H035M (Monochrome)

2 megapixel camera
XG-200C (Color)
XG-200M (Monochrome)

310,000 pixel camera
XG-035C (Color)
XG-035M (Monochrome)



Ultra-compact,
2 megapixel camera
XG-S200C (Color)
XG-S200M (Monochrome)

Ultra-compact,
310,000 pixel camera
XG-S035C (Color)
XG-S035M (Monochrome)

Line scan cameras



8x high-speed, 2048 pixels
Line scan camera
XG-HL02M
(Monochrome)



16x high-speed, 4096 pixels
Line scan camera
XG-HL04M
(Monochrome)



16x high-speed, 8192 pixels
Line scan camera
XG-HL08M
(Monochrome)

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Camera Cables

Camera cable



L-type connector

Amplifier for extension cables

CA-CNX10U
(for standard-speed cameras)

CA-CHX10U
(for high-speed cameras)

Camera cables

Cable type	Connector shape	Cable length					
		1 m 3.3'	3 m 9.8'	5 m 16.4'	10 m 32.8'	17 m 55.8'	Extension cable
Standard-speed camera cable	Straight	**CA-CN1**	**CA-CN3**	**CA-CN5**	**CA-CN10**	**CA-CN17**	—
	L-type	—	**CA-CN3L**	**CA-CN5L**	**CA-CN10L**	**CA-CN17L**	—
Standard high flex robot cable	Straight	—	**CA-CN3R**	**CA-CN5R**	**CA-CN10R**	**CA-CN17R**	**CA-CN7RE (7 m 23.0')**
High-speed camera cable	Straight	—	**CA-CH3**	**CA-CH5**	**CA-CH10**	—	—
	L-type	—	**CA-CH3L**	**CA-CH5L**	**CA-CH10L**	—	—
High-speed high flex robot cable	Straight	—	**CA-CH3R**	**CA-CH5R**	**CA-CH10R**	—	—
Extension cables (Must be used with amplifier)							
Standard-speed extension cable	Straight	—	**CA-CN3X**	—	**CA-CN10X**	**CA-CN17X**	—
	L-type	—	**CA-CN3LX**	—	**CA-CN10LX**	**CA-CN17LX**	—
Standard high flex robot extension cable	Straight	—	**CA-CN3RX**	—	**CA-CN10RX**	**CA-CN17RX**	—
High-speed extension cable	Straight	—	**CA-CH3X**	—	**CA-CH10X**	—	—
High-speed high flex robot extension cable	Straight	—	**CA-CH3RX**	—	**CA-CH10RX**	—	—

List of supported connection of camera cables

Number of pixels of camera the cables can be connected to		Area camera			Line scan camera		
		5,000,000 pixels	2,000,000 pixels	310,000 pixels	8,192 pixels	4,098 pixels	2,048 pixels
For high-speed camera	**CA-CH10**	✓	✓	✓	✓	✓	✓
	CA-CH5	✓	✓	✓	✓	✓	✓
	CA-CH3	✓	✓	✓	✓	✓	✓
For standard camera	**CA-CN17**	—	—	✓	—	—	—
	CA-CN10	—	✓	✓	—	—	—
	CA-CN5	—	✓	✓	—	—	—
	CA-CN3	—	✓	✓	—	—	—
	CA-CN1	—	✓	✓	—	—	—
Maximum length	**CA-CNX10U x1**		20 m 65.6'	34 m 111.6'			
	CA-CNX10U x2		30 m 98.4'	51 m 167.3'			
	CA-CHX10U x1	20 m 65.6'	20 m 65.6'	20 m 65.6'	20 m 65.6'	20 m 65.6'	20 m 65.6'
	CA-CHX10U x2			30 m 98.4'	30 m 98.4'	30 m 98.4'	30 m 98.4'

Monitor/Touch panel



Touch screen
CA-MP120T



CA-MP120T stand
OP-87262

CA-MP120T protective film
OP-87263

CA-MP120T Accessories

XG-7000: **OP-87264** (3 m 9.8' touch panel modular RS-232C cable)
OP-87265 (10 m 32.8' touch panel modular RS-232C cable)

XG-8000: **OP-87258** (3 m 9.8' touch panel RS-232C cable)
OP-87259 (10 m 32.8' touch panel RS-232C cable)

Monitor cable
OP-66842 (3 m 9.8')
OP-87055 (10 m 32.8')



*A RGB monitor cable and touch panel RS-232C cable are required when using the CA-MP120T.

Handheld controller junction cable
OP-87260 (3 m 9.8')
OP-87261 (10 m 32.8')

*Junction cables are required when plugging a handheld controller into the CA-MP120T of CA-MP120T.



8.4" LCD color monitor
CA-MP81



CA-MP81 stand
OP-42278



Pole-mounting bracket
OP-42279

Communication cable

Parallel I/O cable
OP-51657 (3 m 9.8')



Communication cable conversion connector
OP-26486: 9 pins
OP-26485: 25 pins
For 9-pin SYSMAC: **OP-84384**
For 9-pin MELSEC: **OP-86930**



RS-232C communication cable
OP-26487 (2.5 m 8.2')



1Gbps Ethernet cable
OP-66843 (3 m 9.8')



USB cable
OP-66844 (2 m 6.6')



Others



Image processing system integration software
XG-H8NE2
XG-H7NE2



Handheld controller
OP-84231
OP-84236 (no labels)



Dedicated 24 VDC power supply
CA-U4



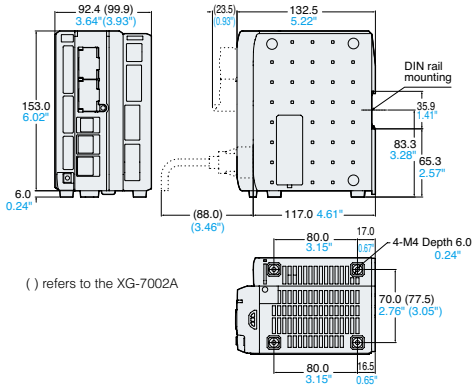
Industrial SD card
CA-SD4G: 4 GB (SDHC)
CA-SD1G: 1 GB
OP-87133: 512 MB



Camera XY adjustment stage
CA-S2040

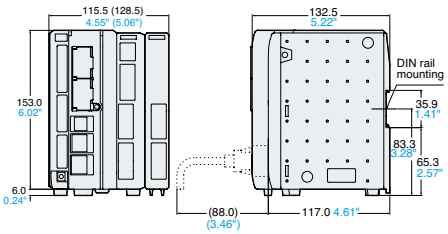
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Controller
XG-7702(P)/XG-7502(P)/XG-7002(P)

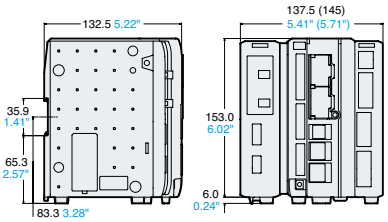


( ) refers to the XG-7002A

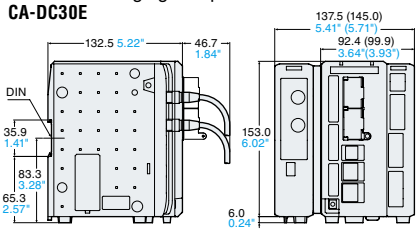
When mounting camera expansion module
XG-E700



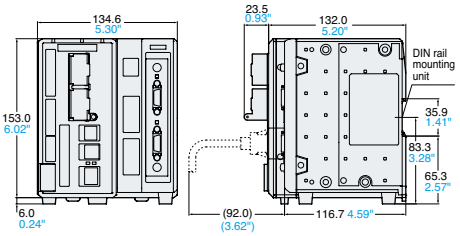
When mounting light expansion module
CA-DC21E

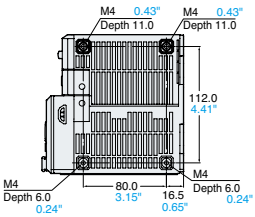


When mounting light expansion module
CA-DC30E

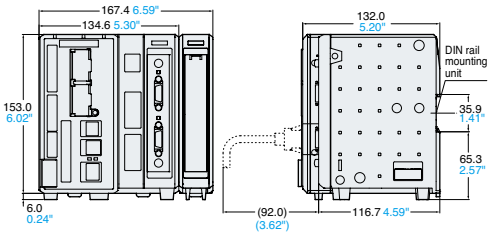


Controller
XG-8702(P)/XG-8502(P)/XG-8002(P)

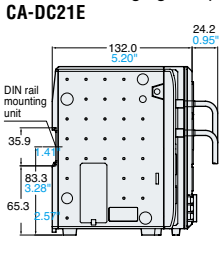


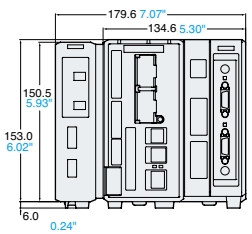


When mounting camera expansion module
CA-E800

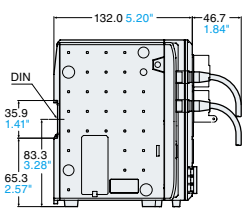


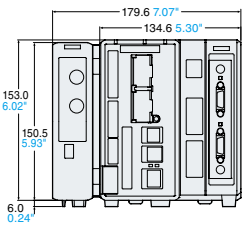
When mounting light expansion module
CA-DC21E



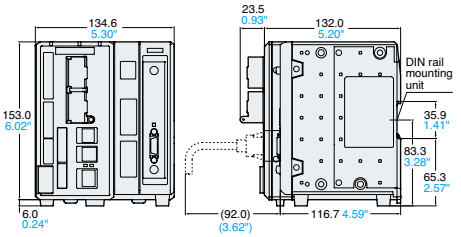


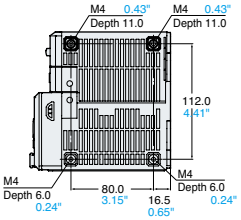
When mounting light expansion module
CA-DC30E



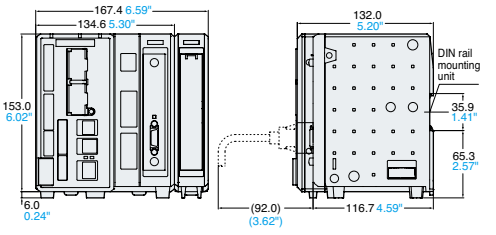


Controller
XG-8502L(P)/XG-8702L(P)

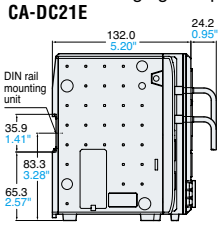


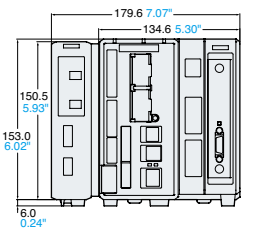


When mounting camera expansion module
CA-E800

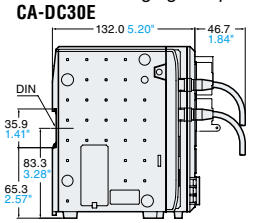


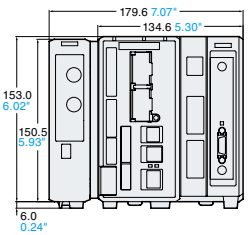
When mounting light expansion module
CA-DC21E





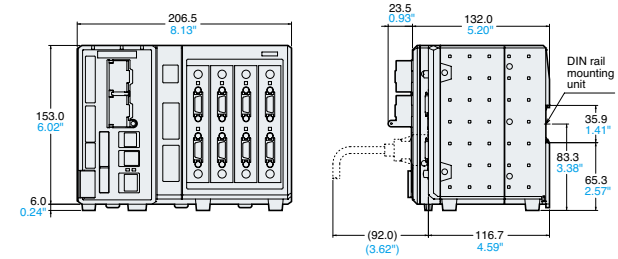
When mounting light expansion module
CA-DC30E

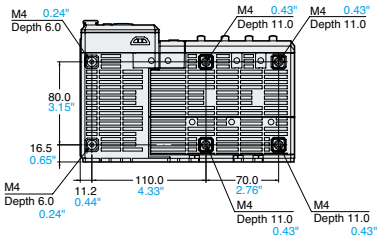




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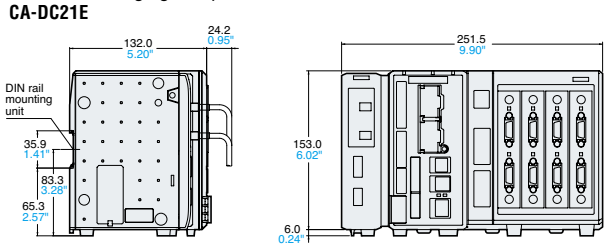
Controller **XG-8802(P)** + When mounting camera expansion module **CA-EC80**



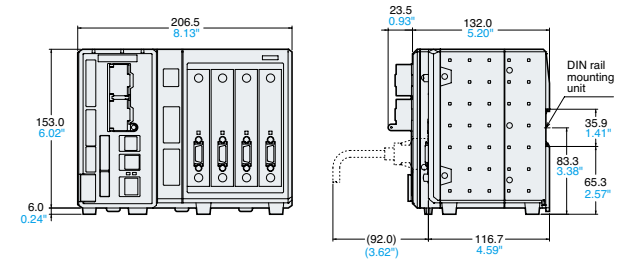


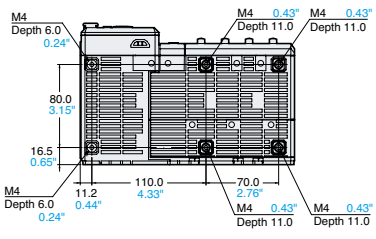
When mounting light expansion module **CA-DC21E**

Unit: mm inch

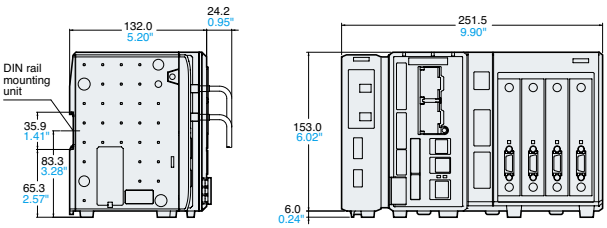


Controller **XG-8802L(P)** + When mounting camera expansion module **CA-EC80L**



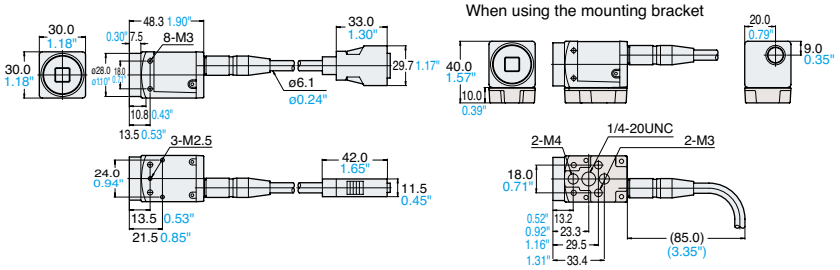


When mounting light expansion module **CA-DC21E**

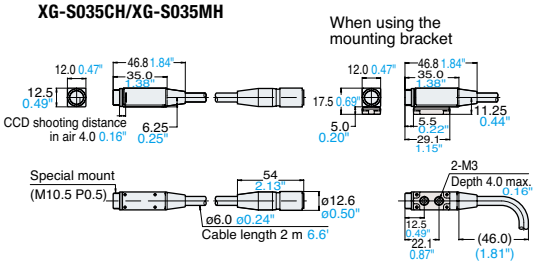


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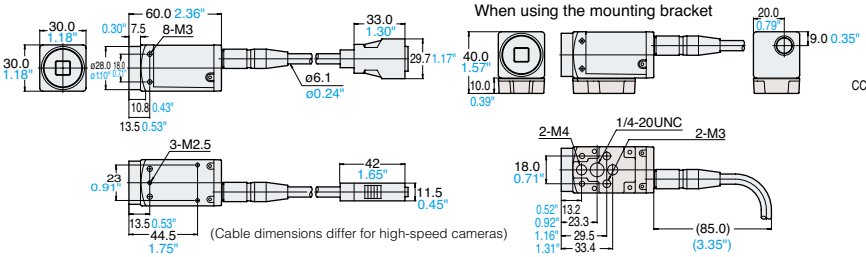
Camera
XG-035C/XG-035M



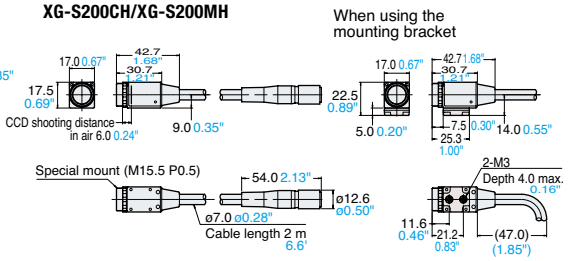
Camera
XG-S035CH/XG-S035MH



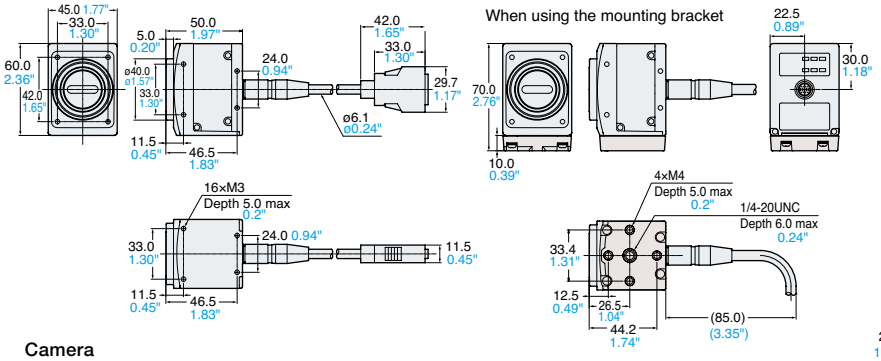
Camera
XG-H500C/XG-H500M/XG-H200C/XG-H200M/XG-200C/XG-200M/XG-H035C/XG-H035M



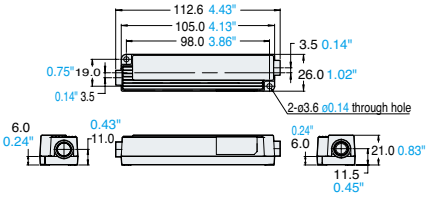
Camera
XG-S200CH/XG-S200MH



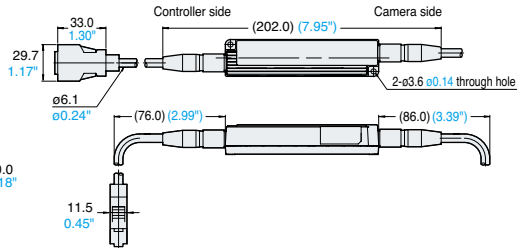
Camera
XG-HL02M/XG-HL04M



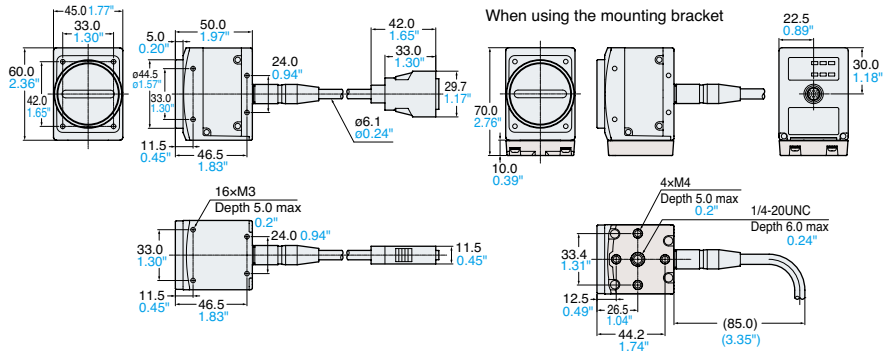
Camera control unit
XG-S200CU/XG-S200MU/XG-S035CU/XG-S035MU



With cable connected



Camera
XG-HL08M



Camera cable
CA-CN1 (1 m 3.3')/CA-CN3 (3 m 9.8')/CA-CN5 (5 m 16.4')/
CA-CN10 (10 m 32.8')/CA-CN17 (17 m 55.8')

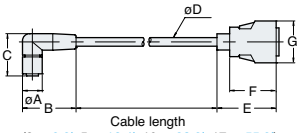
High-flex camera cable
CA-CN3R (3 m 9.8')/CA-CN5R (5 m 16.4')/CA-CN10R (10 m 32.8')/
CA-CN17R (17 m 55.8')

Cable dedicated for high-speed cameras
CA-CH3 (3 m 9.8')/CA-CH5 (5 m 16.4')/CA-CH10 (10 m 32.8')

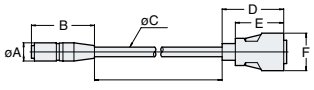
High-flex cable dedicated for high-speed cameras
CA-CH3R (3 m 9.8')/CA-CH5R (5 m 16.4')/CA-CH10R (10 m 32.8')

L-shaped connector camera cable
CA-CN3L (3 m 9.8')/CA-CN5L (5 m 16.4')/
CA-CN10L (10 m 32.8')/CA-CN17L (17 m 55.8')

L-shaped connector cable for high-speed cameras
CA-CH3L (3 m 9.8')/CA-CH5L (5 m 16.4')/
CA-CH10L (10 m 32.8')



	A	B	C	D	E	F	G
L-shaped connector camera cable **CA-CNxL**	14 0.55"	38 1.50"	30 1.18"	6.1 0.24"	42 1.65"	33 1.30"	29.7 1.17"
L-shaped connector cable for high-speed cameras **CA-CHxL**	14 0.55"	38 1.50"	30 1.18"	7.2 0.28"	41 1.61"	31 1.22"	31.4 1.24"



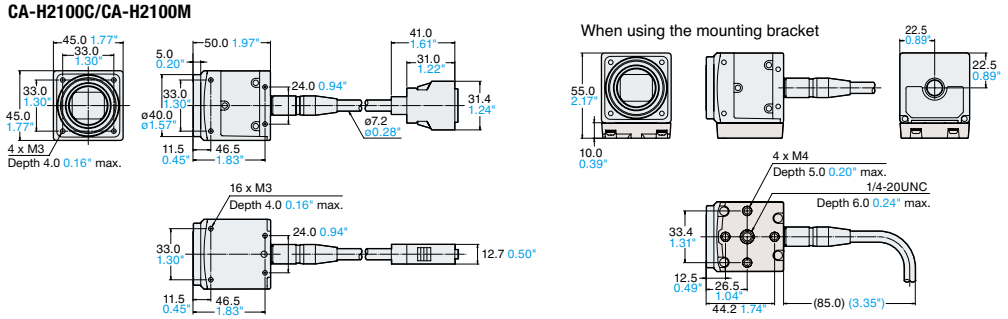
	A	B	C	D	E	F
CA-CNx	12.5 0.49"	43 1.69"	6.1 0.24"	42 1.65"	33 1.30"	29.7 1.17"
CA-CNxR	14.0 0.55"	54 2.13"	6.6 0.26"	42 1.65"	33 1.30"	29.7 1.17"
CA-CHx	12.5 0.49"	43 1.69"	7.2 0.28"	41 1.61"	31 1.22"	31.4 1.24"
CA-CHxR	14.0 0.55"	54 2.13"	7.6 0.30"	41 1.61"	31 1.22"	31.4 1.24"

Please refer to the "Vision System Peripheral Equipment catalog" in regards to any dimensional diagrams of additional devices that have not been included here.

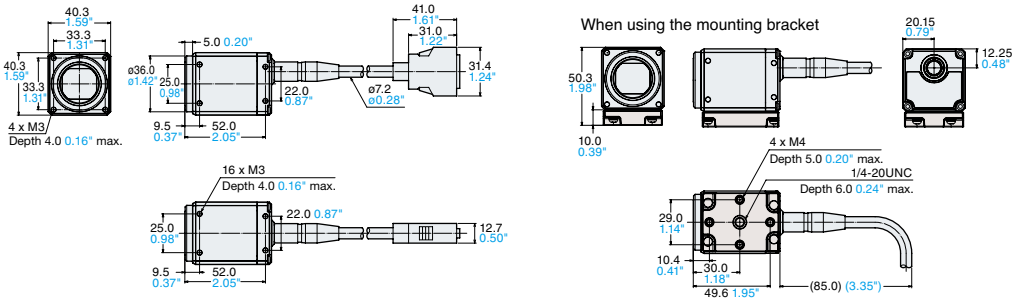
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Unit: mm inch

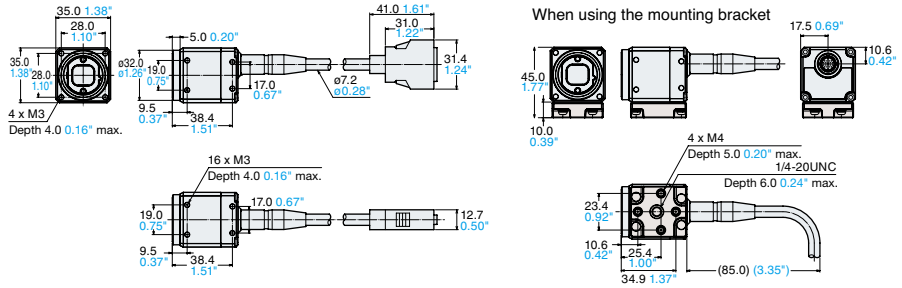
Camera
CA-H2100C/CA-H2100M



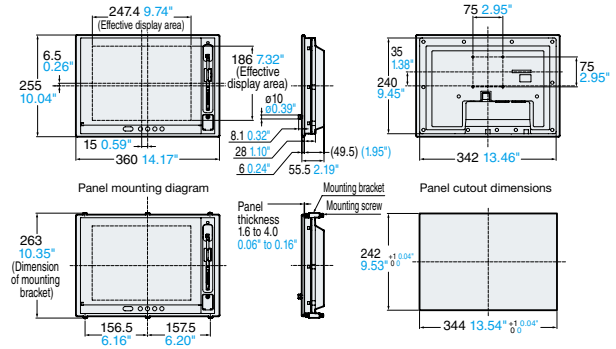
Camera
CA-HX500C/CA-HX500M/CA-HX200C/CA-HX200M



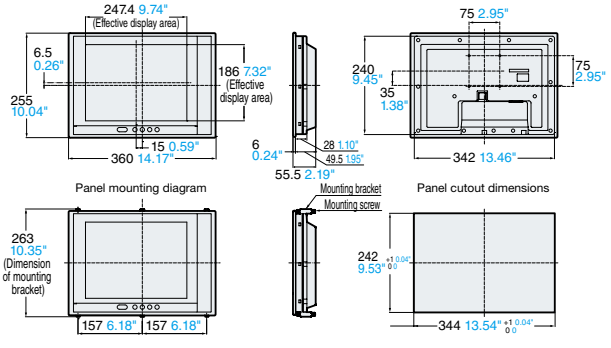
Camera
CA-HX048C/CA-HX048M



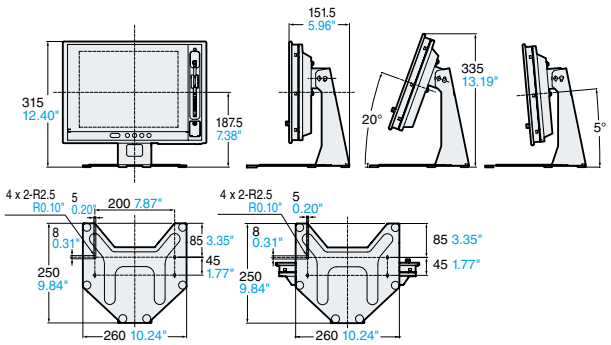
Touch panel LCD monitor
CA-MP120T



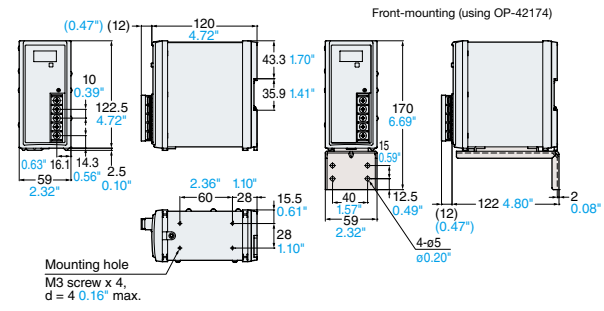
LCD monitor
CA-MP120



Monitor stand
OP-87262



Dedicated 24 VDC power supply
CA-U4



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When looking for a vision system to solve your application needs, we understand it can be stressful and risky. This is why we offer different ways to make sure your application is solved and implemented properly.

Direct Sales



KEYENCE's philosophy is to work closely with the customer to provide the best satisfaction available. This is why we do not sell through distributors, but instead work with the customers directly. Each of our sales engineers are fully trained on our vision systems and are experts at what they are selling. This means they can provide a complete solution to you before the sale and support it after the sale. This is the advantage of Direct Sales.

Vision Testing

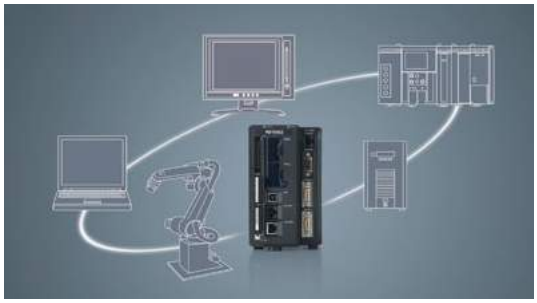


Let us prove that we can provide you with a complete solution. Our sales engineers will do testing on your application to fully understand the details of the project. We also have a team of application engineers for those tough applications where they can provide even further expertise to solve the application.

Trial Units

Take our vision systems on a test drive! We offer trial units to our customers at no cost. This will allow us to prove to you that our vision system will provide you a stable solution and peace of mind when you decide to use KEYENCE vision systems for your application.

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We have a list of preferred system integrators who have been specifically trained on KEYENCE vision systems. They are fully capable of integrating our vision systems in a wide range of facilities and have experience doing so. We can recommend their service if the application is complex or if you need to implement the solution rapidly.

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Here at KEYENCE we pride ourself on the quality of our after sales support on all our products and the XG Series is no exception. We offer many different types of support to assist with using KEYENCE's range of machine vision systems. In addition to our technically trained workforce, support services include: free training workshops, free software upgrades, example programs, technical guides, online resources and dedicated technical support.

XG User Support Webpage www.visionsystem.com

In addition to the standard KEYENCE websites, there is a dedicated XG Series support website that is specifically designed for providing answers to questions, example programs and software to assist any XG Series user.



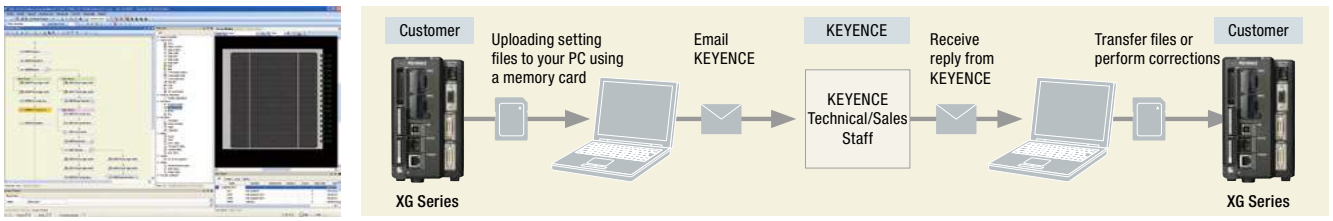
Get Familiar with the XG

Our XG Getting Started movies will help you quickly get accustomed to the XG Series. These videos are informative and easy to follow and cover everything from programming vision tools to setting up I/O!



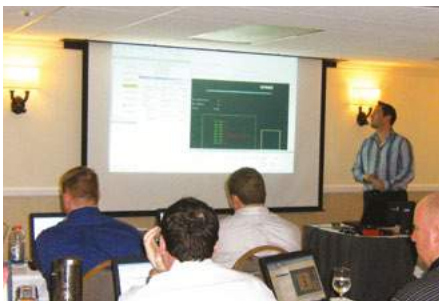
Free remote support and testing with the XG Simulator+

The XG Simulator+ software can be downloaded free of charge from the XG User Support webpage enabling remote testing and support of any XG program.
By emailing images and setting files directly to KEYENCE technical support, we can answer any questions you may have concerning your application or program. New applications can also be sent directly to KEYENCE for free testing and evaluation by dedicated application engineers.



Free XG Series Workshops www.visionsystem.com

KEYENCE offers free training workshops designed to increase the skills and capability of users that would like to implement the XG Series for their vision application needs. Contact KEYENCE directly for more details.



XG Series Training Course

Aimed at experienced vision users wanting to learn how to fully take advantage of the advanced functionality of the XG.

This training course is designed to develop XG machine vision knowledge, allowing users to fully implement the XG for a wide variety of applications.

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